SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE UNIVERSE AS AN ORGANISM.*

IF I were called upon to convey, within the compass of a single sentence, an idea of the trend of recent astronomical and physical science, I should say that it was in the direction of showing the universe to be a connected whole. The farther we advance in knowledge, the clearer it becomes that the bodies which are scattered through the celestial spaces are not completely independent existences, but have, with all their infinite diversity, many attributes in common.

In this we are going in the direction of certain ideas of the ancients which modern discovery long seemed to have contradicted. In the infancy of the race, the idea that the heavens were simply an enlarged and diversified earth, peopled by beings who could roam at pleasure from one extreme to the other, was a quite natural one. The crystalline sphere or spheres which contained all formed a combination of machinery revolving on a single plan. But all bonds of unity between the stars began to be weakened when Copernicus showed that there were no spheres, that the planets were isolated bodies, and that the stars were vastly more distant than the planets. As discovery went on and our conceptions of the universe were

* Address before the Astronomical and Astrophysical Society of America, December 29, 1902.

enlarged, it was found that the system of the fixed stars was made up of bodies so vastly distant and so completely isolated that it was difficult to conceive of them as standing in any definable relation to each other. It is true that they all emitted light, else we could not see them, and the theory of gravitation, if extended to such distances, a fact not then proved, showed that they acted on each other by their mutual gravitation. But this was all. Leaving out light and gravitation, the universe was still, in the time of Herschel, composed of bodies which, for the most part, could not stand in any known relation one to the other.

When, forty years ago, the spectroscope was applied to analyze the light coming from the stars, a field was opened not less fruitful than that which the telescope made known to Galileo. The first conclusion reached was that the sun was composed almost entirely of the same elements that existed upon the earth. Yet, as the bodies of our solar system were evidently closely related, this was not remarkable. But very soon the same conclusion was, to a limited extent, extended to the fixed stars in general. Such elements as iron, hydrogen and calcium were found not to belong merely to our earth, but to form important constituents of the whole universe. We can conceive of no reason why, out of the infinite number of combinations which might make up a spectrum, there should not be a separate kind of matter for each combination. So far as we know, the elements might merge into each other by insensible gradations. It is, therefore, a remarkable and suggestive fact when we find that the elements which make up bodies so widely separate that we can hardly imagine them having anything in common, should be so much the same.

In recent times what we may regard as a new branch of astronomical science is being developed, showing a tendency toward unity of structure throughout the whole domain of the stars. This is what we now call the science of stellar statistics. The very conception of such a science might almost appal us by its immensity. The widest statistical field in other branches of research is that occupied by sociology. Every country has its census, in which the individual inhabitants are classified on the largest scale and the combination of these statistics for different countries may be said to include all the interest of the human race within its scope. Yet this field is necessarily confined to the surface of our planet. In the field of stellar statistics millions of stars are classified as if each taken individually were of no more weight in the scale than a single inhabitant of China in the scale of the sociologist. And yet the most insignificant of these suns may, for aught we know, have planets revolving around it, the interests of whose inhabitants cover as wide a range as ours do upon our own globe.

The statistics of the stars may be said to have commenced with Herschel's gauges of the heavens, which were continued from time to time by various observers, never, however, on the largest scale. The subject was first opened out into an illimitable field of research through a paper presented by Kapteyn to the Amsterdam Academy of Sciences in 1893. The capital results of this paper were that different regions of space contain different kinds of stars and, more especially, that the stars of the Milky Way belong, in part at least, to a different class from those existing elsewhere. Stars not belonging to the Milky Way are, in large part, of a distinctly different class. Yet, the extent of each of these classes is as great as that of the universe. Throughout the whole of the extent of the latter, we find in one direction a certain class of stars to be pre-

dominant and throughout its whole circuit in other directions, a different class.

This supposition was still farther emphasized through the researches of Seeliger on the distribution of the stars in space. He exclaimed, with what we might regard as a pardonable approach to enthusiasm not common in a mathematical discussion, that the Milky Way was now to be regarded as a single object. Another curious fact is that, within it, the stars, so far as we can yet determine, seem to be equally scattered from one extreme to the other. In two opposite directions, that of the poles of the Milky Way, the number of stars which we see are fewest. Their thickness increases, slowly at first, then more rapidly, until we reach the Milky Way itself. So far as has yet been determined there is a perfect symmetry on the two sides of the Milky Way. If, on one side the stars seem to be a little thicker here than on the corresponding side, the case is the reverse in some other regions. The general rule is that if we take two diametrically opposite directions in the heavens, no matter which, and count the number of stars within a given area of, say, ten square degrees in each of these opposite directions, we shall find the number to be nearly the same. The nearer our directions come to the plane of the Milky Way, the more numerous the stars we shall find in the two opposite cases, but the increase in thickness will not be much greater at one end of our line of sight than at the opposite end. Moreover, if we change the direction of this imaginary diameter of the universe, we shall find that, so long as it makes the same angle with the Milky Way, so long will the number of stars around it remain the same. The statistical evidence also shows us that the stars of the Milky Way are, in a general average, several times as bright as those situated elsewhere.

The feature of the universe which should therefore command our attention is the arrangement of a large part of the stars which compose it in a ring, seemingly alike in all its parts, so far as general features are concerned. So far as research has yet gone, we are not able to say decisively that one region of this ring differs essentially from another. It may, therefore, be regarded as forming a structure built on a uniform plan throughout.

All scientific conclusions drawn from statistical data require a critical investigation of the basis on which they rest. If we are going, from merely counting the stars, observing their magnitudes and determining their proper motions, to draw conclusions as to the structure of the universe in space, the question may arise how we can form any estimate whatever of the possible distance of the stars, a conclusion as to which must be the very first step we take. We can hardly say that the parallaxes of more than 100 stars have been measured with any approach to certainty. The individuals of this 100 are situated at very different distances from us. We hope, by long and repeated observations, to make a fairly approximate determination of the parallaxes of all the stars whose distance is less than 20 times that of α Centauri. But how can we know anything about the distance of stars outside this sphere? What can we say against the view of Kepler that the space around our sun is very much thinner in stars than it is at a greater distance; in fact that the great mass of the stars may be situated between the surfaces of two concentrated spheres not very different in radius. May not this universe of stars be somewhat in the nature of a hollow sphere?

This objection requires very careful consideration on the part of all who draw conclusions as to the distribution of stars in space and as to the extent of the visible

universe. The steps to a conclusion on the subject are briefly these: First we have a general conclusion, the basis of which I have already set forth, that, to use a loose expression, there are likenesses throughout the whole diameter of the universe. There is, therefore, no reason to suppose that the region in which our system is situated differs in any essential degree from any other region near the central portion. Again, spectroscopic examinations seem to show that all the stars are in motion, and that we cannot say that those in one part of the universe move more rapidly than those in another. This result is of the greatest value for our purposes, because, when we consider only the apparent motions, as ordinarily observed, these are necessarily dependent upon the distance of the star. We cannot, therefore, infer the actual speed of a star from ordinary observations until we know its distance. But the results of spectroscopic measurements of radial velocity are independent of the distance of the star.

But let us not claim too much. We can not yet say with certainty that the stars which form the agglomerations of the Milky Way have, beyond doubt, the same average motion as the stars in other regions of the universe. The difficulty is that these stars appear to us so faint individually, that the investigation of their spectra is still beyond the powers of our instruments. But the extraordinary feat performed at the Lick Observatory of measuring the radial motion of 1830 Groombridge, a star quite invisible to the naked eye, may lead us to hope for a speedy solution of this question. But we need not await this result in order to reach very probable conclusions. The general outcome of researches on proper motions tends to strengthen the conclusions that the Keplerian sphere, if I may use this expression, has no very well marked existence. The laws of stellar velocity and the statistics of proper motions, while giving some color to the view that the space in which we are situated is thinner of stars than elsewhere, yet show that, as a general rule, there are no great agglomerations of stars elsewhere than in the region of the Milky Way.

With unity there is always diversity; in fact the unity of the universe on which I have been insisting consists in part of diversity. It is very curious that, among the many thousands of stars which have been spectroscopically examined, no two are known to have absolutely the same physical constitution. It is true that there are a great many resemblances. α Centauri, our nearest neighbor, if we can use such a word as 'near' in speaking of its distance, has a spectrum very like that of our sun, and so has Capella. But even in these cases careful examination shows differences. These differences arise from variety in the combinations and temperature of the substances of which the star is made up. Quite likely also, elements not known on the earth may exist in the stars, but this is a point on which we cannot yet speak with certainty.

Perhaps the attribute in which the stars show the greatest variety is that of absolute luminosity. One hundred years ago it was naturally supposed that the brighter stars were the nearest to us, and this is doubtless true when we take the general average. But it was soon found that we cannot conclude that because a star is bright, therefore it is near. The most striking example of this has been brought out by the researches of Gill on the parallax of Rigel, the brightest star in Orion, and of Canopus, which is, next to Sirius, the brightest star in the heavens. In both these cases the parallax from a long series of measurements, extending through several years, came out just zero. These stars, then, though of the first magnitude, are immeas-

urably distant. A remarkable fact is that these conclusions coincide with that which we draw from the minuteness of the proper motions. Rigel has no motion that has certainly been shown by more than a century of observation, and it is not certain that Canopus has either. From this alone we may conclude, with a high degree of probability, that the distance of each is immeasurably great. We may say with certainty that the brightness of each is thousands of times that of the sun and with a high degree of probability, that it is hundreds of thousands of times. On the other hand, there are stars comparatively near us of which the light is not the hundredth part that of the sun.

The universe may be a unit in two ways. One is that unity of structure to which our attention has just been directed. This might subsist forever without one body influencing another. The other form of unity leads us to view the universe as an organism. It is such by mutual action going on between its bodies. A few years ago we could hardly suppose or imagine that any other agents than gravitation and light could possibly pass through spaces so immense as those which separate the stars.

The most remarkable and hopeful characteristic of the unity of the universe is the evidence which is being gathered that there are other agencies whose exact nature is yet unknown to us, but which do pass from one heavenly body to another. The best established example of this yet obtained is afforded in the case of the sun and the earth.

The fact that the frequency of magnetic storms goes through a period of about eleven years, and is proportional to the frequency of sun spots, has been well established. The recent work of Professor Bigelow shows the coincidence to be of remarkable exactness, the curves of the two phenomena being practically coincident so far as their general features are concerned. The conclusion is that spots on the sun and magnetic storms are due to the same cause. This cause can not be any change in the ordinary radiation of the sun, because the best records of temperature show that, to whatever variations the sun's radiation may be subjected, they do not change in the period of the sunspots. To appreciate the relation, we must recall that the researches of Hale with the spectroheliograph show that spots are not the primary phenomenon of solar activity, but are simply the outcome of processes going on constantly in the sun which result in spots only in special regions and on special occasions. It does not, therefore, necessarily follow that a spot does cause a magnetic storm. What we should conclude is that the solar activity which produces a spot also produces the magnetic storm.

When we inquire into the possible nature of these relations between solar activity and terrestrial magnetism, we find ourselves so completely in the dark that the question of what is really proved by the coincidence may arise. Perhaps the most obvious explanation of fluctuations in the earth's magnetic field to be inquired into would be based on the hypothesis that the space through which the earth is moving is in itself a varying magnetic field of vast extent. This explanation is tested by inquiring whether the fluctuations in question can be explained by supposing a disturbing force which acts substantially in the same direction all over the globe. But a very obvious test shows that this explanation is untenable. Were it the correct one, the intensity of the force in some regions of the earth would be diminished and in regions where the needle pointed in the opposite direction would be increased in exactly the same degree. But there is no

relation traceable either in any of the regular fluctuations of the magnetic force, or in those irregular ones which occur during a magnetic storm. If the horizontal force is increased in one part of the earth, it is very apt to show a simultaneous increase the world over, regardless of the direction in which the needle may point in various localities. It is hardly necessary to add that none of the fluctuations in terrestrial magnetism can be explained on the hypothesis that either the moon or the sun acts as a magnet. In such a case the action would be substantially in the same direction at the same moment the world over.

Such being the case, the question may arise whether the action producing a magnetic storm comes from the sun at all, and whether the fluctuations in the sun's activity, and in the earth's magnetic field may not be due to some cause external to both. All we can say in reply to this is that every effort to find such a cause has failed and that it is hardly possible to imagine any cause producing such an effect. It is true that the solar spots were, not many years ago, supposed to be due in some way to the action of the planets. But, for reasons which it would be tedious to go into at present, we may fairly regard this hypothesis as being completely disproved. There can, I conclude, be little doubt that the eleven-year cycle of change in the solar spots is due to a cycle going on in the sun itself. Such being the case, the corresponding change in the earth's magnetism must be due to the same cause.

We may, therefore, regard it as a fact sufficiently established to merit further investigation that there does emanate from the sun, in an irregular way, some agency adequate to produce a measurable effect on the magnetic needle. We must regard it as a singular fact that no observations yet made give us the slightest indication as to what this emanation is. The possibility of defining it is suggested by the discovery within the past few years, that under certain conditions, heated matter sends forth entities known as Röntgen rays, Becquerel corpuscles and electrons. I can not speak authoritatively on this subject, but, so far as I am aware, no direct evidence has yet been gathered showing that any of these entities reach us from the sun. We must regard the search for the unknown agency so fully proved as among the most important tasks of the astronomical physicist of the present time. From what we know of the history of scientific discovery, it seems highly probable that, in the course of his search, he will, before he finds the object he is aiming at, discover many other things of equal or greater importance of which he had, at the outset, no conception.

In his study of what is going on among the stars, even the astronomer may for a time fail to grasp the true significance of what he sees through leaving out of account the vastness of the field which he is surveying. A remarkable case of this is seen in the case of the new stars which have been known to burst forth from time to time. In at least two notable cases of this kind within the past ten years, such stars have been found, within a few months after their outburst, to be changed into or surrounded by a nebula. Nothing could, at first sight, seem more natural or easily explained than this occurrence. To whatever cause we may attribute such a catastrophe as the sudden multiplication, within the period of two or three days, of the light of a sun by thousands of times, the cataclysm must result in throwing out a mass of incandescent vapor, rising with great speed. This vapor expanding on all sides, will appear to us as a nebula surrounding the star and continually enlarging. That any difficulty can stand in the way of this view will first appear when we make an estimate of the prob-

able extent of such a nebula. To do this requires that we know something of the distance of the star. This can not be determined by any absolute method, so that our conclusions as to the distance must in part be conjectural. Yet we can say with a high degree of probability that the annual parallax of these new stars can scarcely be much greater than the thousandth of a second. We have two independent bases for this conclusion.

One is that such stars have never blazed forth except in the regions of the Milky Way. We are, therefore, justified in believing them as distant as the Milky Way. Now one of the results of stellar statistics which we need not stop to reason out at the present time is that the distance of the Milky Way can scarcely be much less than that corresponding to the parallax I have indicated. Even this distance falls far short of the estimates of Sir William Herschel, who is stated to have placed the outermost visible stars of our system at a distance which light would require many thousand years to traverse. He supposed us to see all the stars of the Milky Way by pre-Adamite light. But the distance which I have indicated is that over which light would travel in about 3,400 years.

The other argument on the subject may be briefly stated in this form. From what we know of the thickness of the stars in our immediate neighborhood, there is every reason to believe that, out of several hundreds of million of stars in the universe, not more than twenty thousand are within the distance corresponding to a parallax of 0″.02. The chances are, therefore, more than ten thousand to one that any star in the universe, taken at random, would lie within this range of distance from us.

Another reason for placing the Milky Way, and with it the new stars, at this distance is found in the absence of proper motions from such stars. Most careful and refined measures made by Barnard on Nova Persei show a motion of only 0″.01 in the course of a year, which is only saying that no motion has been seen. Although this result is not conclusive, it affords additional very strong evidence in favor of the view that this star was really in the region of the Milky Way.

Assuming, then, that the distance is of this order of magnitude, let us ask at what speed a nebula must rise in order that it may expand as rapidly as observation seems to show the matter around Nova Persei to have flown outward. Calculations would show this speed to beggar all our conceptions. The highest speed which matter has been known to reach is that attained by the eruption of hydrogen and other gases from the sun, which sometimes amounts to several hundred miles a second. But matter moving only with such a speed as this would require centuries to form a nebula of appreciable size at the distance we have assigned to the new stars.

The application of this principle to the case of Nova Persei led to an ingenious suggestion by Kapteyn that the seemingly slow expansion of the nebula which surrounds Nova Persei was not a motion of matter at all, but only an illumination of nebulous matter already existing by the wave of light thrown out from the exploded star. At first sight the reply to this suggestion might be that the observed expansion can not come up to light in speed. One might be astonished to hear that, inconceivably swift as is the motion of light, it might be well that, at such a distance, it would seem to us as slow as the apparent expansion of the nebula in question. But when we put the matter into cold figures, we find that the great difficulty in the way of accepting Kapteyn's explanation is the opposite of this. What we have to deal with is not the apparent slowness of the motion, but the in-

adequacy of the speed of light to explain the phenomena. If the distance of this star is only 400 times that of α Centauri, the speed of the apparent expansion must have been ten times that of light.

Of all agencies known to be propagated through space in time, light is the swiftest in its motion. We may, therefore, say that no known cause coming into action in February, 1901, could, within the twenty-two months which have since elapsed, have emanated from the star so as to make itself felt outside of a sphere which, at the distance in question, would subtend to our eyes an angle of more than four minutes in diameter. We seem, therefore, forced to the conclusion that either the illumination or nebulosity surrounding Nova Persei during the summer of 1902 existed independently of the outburst of the star, or there exists in the universe a cause susceptible of transmission with a speed several times that of light.

When we look closely into the matter, we find some difficulty in proposing any hypothesis based on the known action of natural agents. A continual course of self discipline is necessary to enable us to appreciate the real significance of the question. The facts, as I understand them, are briefly these: We see by photography an object in the heavens in which certain changes are going on consisting of variations in the appearance of the illuminated portions. Day after day we see that a certain illumination beginning at a point A, no matter where, spreads to a point B, and perhaps a point of light, C, begins to show itself. The natural conclusion is that something is being propagated. The point B has received an emanation from A and the point C has not appeared spontaneously, but has been connected with something going on at some other point, perhaps the central star. In attributing this propagation to that of anything but light and radiant heat, we are met by the difficulty that all other known natural causes which could have operated in such a case fall short of this in their speed of transmission.

Whichever way we turn we meet with difficulties which seem insuperable in constructing any theory that will explain the observed phenomena. The light theory which I have mentioned is rendered more unlikely from the fact that the latest researches upon the Lick photographs seem to show that the emanation did not go out in straight lines with uniform velocity, but branched off here and there, sometimes in one direction and sometimes in another, with varying speed. There is a difficulty in attributing the apparent expansion to the motion of light which seems yet greater than this. The speed of light is perfectly uniform. The outburst was extremely sudden, it being only two or three days from the time when the star became visible until it reached first magnitude. Under the circumstances the outgoing light-wave would have been a well-defined spherical surface, brighest at a point so near the actual surface that its extent would not be visible at such a distance. The star faded away at a rate which reduced it to one half in a very few days and again to one half in a few days more. The light emanating from such an object would, therefore, have presented to our eyes the appearance of a well-defined luminous circular disc, brightest at the circumference outside of which all would have remained in complete darkness. It is true that, owing to the difference of density of the material reflecting the light, the disc would not have been uniform. It might have many gaps here and there and present a cloudy appearance. But with all these differences the boundary would have been as well defined as if the disc had been turned in a lathe.

This would suggest our having recourse to the corpuscles of which the investigation is now beginning and may be the main subject of physical research during the next generation. But here, if we accept the theoretical result of Professor J. J. Thomson, we meet with the difficulty that these entities can not travel with a greater speed than that of light. Under these circumstances nothing seems left for us in the present state of our knowledge but to turn over to our successors the problem of explaining the phenomena.

The main point I desire to bring out in this review is the tendency which it shows towards unification in physical research. Heretofore differentiation—the subdivision of workers into a continually increasing number of groups of specialists—has been the rule. Now we see a coming together of what, at first sight, seem the most widely separated spheres of activity. What two branches could be more widely separated than that of stellar statistics, embracing the whole universe within its scope, and the study of these newly-discovered emanations, the product of our laboratories, which seem to show the existence of corpuscles smaller than the atoms of matter? And yet, the phenomena which we have reviewed, especially the relation of terrestrial magnetism to the solar activity, and the formation of nebulous masses around the new stars, can be accounted for only by emanations or forms of force, having probably some similarity with the corpuscles, electrons and rays which we are now producing in our laboratories. The nineteenth century, in passing away, points with pride to what it has done. It has become a word to symbolize what is most important in human progress. Yet, perhaps its greatest glory may prove to be that the last thing it did was to lay a foundation for the physical science of the twentieth century. What shall be discovered in the new fields is, at present, as far without our ken as were the modern developments of electricity without the ken of the investigators of one hundred years ago. We can not guarantee any special discovery. What lies before us is an illimitable field, the existence of which was scarcely suspected ten years ago, the exploration of which may well absorb the activities of our physical laboratories, and of the great mass of our astronomical observers and investigators for as many generations as were required to bring electrical science to its present state. We of the older generation can not hope to see more than the beginning of this development, and can only tender our best wishes and most hearty congratulations to the younger school whose function it will be to explore the limitless field now before it.

S. NEWCOMB.

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*PLANS OF THE NEW BUILDINGS FOR THE NATIONAL BUREAU OF STANDARDS.**

THE work for which the National Bureau of Standards was established includes research and testing in the domain of physics, extending into the field of chemistry on the one hand and of engineering on the other. The union of research and testing in one institution is of supreme importance, the investigations being, of course, primarily designed to carry the work of standardization and testing to the highest possible efficiency. The Physikalisch-Technische Reichsanstalt is an illustrious example before all the world of how much can be accomplished where research and testing are combined in one institution; and that the union should be intimate is further shown by the fact that more or less research is carried on in the second, or technical, division of the Reichsanstalt, instead of being confined to the first

* A paper read before the Philosophical Society of Washington, October 25, 1902.

division, which is especially the division of research.

At the very outset the director of the Bureau of Standards realized the advantages of this intimate association of research and testing, and no attempt was made or will be made to separate them into two divisions. The laboratory requirements are, therefore, those of a research laboratory plus whatever special facilities may be needed for commercial testing. In addition to the workers themselves there is then required: (1) A suitable place in which to work; (2) an equipment of apparatus, tools and machines; and (3) facilities and appliances for providing the proper conditions for experimental work.

To meet these requirements Congress has already authorized the expenditure of $25,000 for a site, $325,000 for buildings, and $40,000 for equipment. Further appropriations for equipment and personnel will be made as needed.

The site lies in the northwestern suburbs of Washington, about three and one half miles from the Treasury and 1,000 feet from Connecticut Avenue, just north of Cleveland Park. It is 350 feet above the Potomac, and is the highest ground in that vicinity. Complete freedom from the jarring of street traffic is assured, and magnetic disturbances due to the only electric railway in that immediate region will be very slight.

1. Two buildings have been planned, one of which is now under construction; the plans for the other are completed and its construction will soon begin. The larger of the two, which is called the physical building, will provide for that part of the experimental work which ought to be kept free from mechanical and magnetic disturbances, and to this end will contain scarcely any machinery. It will also contain the offices for administration and the library, and a well-equipped chemical laboratory. The mechanical laboratory contains the mechanical plant, instrument shop, and laboratories for the heavier kinds of experimental work, where considerable power or large electric currents are required. These two buildings are to be united by a spacious tunnel, through which air ducts, steam, gas and water pipes, and electric circuits are to be carried from the mechanical to the physical laboratory. The mechanical laboratory was begun last July, and will cost about $125,000, including the heating and ventilating plant. The physical building will cost about $200,000 exclusive of equipment and including the connecting tunnel.

2. Considerable progress has already been made in procuring an equipment of apparatus, tools and machines. In addition to the fifteen rooms in the U. S. Coast and Geodetic Survey buildings, occupied by the bureau last year, a large four-story residence at 235 New Jersey Avenue, SE., has recently been leased and equipped as a temporary instrument shop and laboratory. A small brick building in the rear has been converted into an engine and dynamo room, and in the basement of the house a storage battery room and a second dynamo room, the latter for a distributing switchboard and experimental alternators, have been fitted up. A storage battery of 132 cells, of 200 ampère hours capacity, furnishes power for current and lighting and experimental purposes. A low voltage battery giving 1,000 ampères, and two high voltage batteries of 1,000 cells each, have also been provided. During the past year the director and two other officers of the bureau (Drs. Wolff and Waidner) have visited the principal government laboratories and instrument makers of Europe. The instrument shop is well

equipped with motor-driven machines and hand tools, and two mechanicians and a carpenter are now at work. The apparatus and machinery now in use in the temporary quarters is a part of the permanent equipment of the new buildings. A considerable sum of money will, of course, be needed to complete the equipment.

3. The facilities and appliances for carrying on an experiment under the proper conditions are more difficult to secure than the apparatus itself. In general, laboratory rooms should be well lighted and ventilated, and their temperature should be under control. The windows should be double, in order that the space near the windows (often the most valuable in the laboratory) may be warmer in cold weather and cooler in warm weather, and freer from drafts of air, than would be the case with single windows. It should be possible quickly and conveniently to darken many if not all the rooms. The temperature of the laboratory should be automatically controlled by thermostats, so that any temperature (within certain limits) which may be required by a particular experiment or investigation may be maintained, both day and night if necessary for any desired period. The humidity of the air should be low, so that moisture developed in the room either by respiration or evaporation may be absorbed by the air and carried away instead of depositing on the walls and furniture of the room and apparatus. These last considerations, the control of the temperature and humidity of the air, are vital. Many kinds of work can, ordinarily, be done only in the winter months, because summer temperature and summer humidity can not be controlled. This involves not only long delays, but perhaps a large amount of extra labor. This is perhaps oftenest the case in electrical work, but in many other instances it is equally important. Apparatus, tools and machines often suffer by rusting in summer, in spite of the fact that the attendant means to be careful. Hence, in a laboratory where work is to be carried on during the entire year, and where a large quantity of valuable apparatus and instruments of precision are in use, and where, in addition, valuable apparatus is to be received from outside for testing, the necessity of controlling the humidity as well as the temperature of the room is evident.

The temperature of a room may be automatically controlled by means of a thermostat, using either steam or hot air for heating. Hot air, however, possesses three important advantages over steam. In the first place, steam pipes occupy valuable space in a laboratory, usually near the windows or along the walls, where apparatus or benches would otherwise be placed. If they are of iron, their magnetization by the earth's field changes with their temperature, and since the temperature of the room is regulated automatically by shutting off and readmitting the steam, this causes frequent and annoying changes in the magnetic field within the room. In the second place, heating by air affords the best possible ventilation, which is apt to be insufficient in a steam-heated building. And in the third place, heating by air enables the temperature to be automatically controlled in the summer as well as in winter if facilities are provided for cooling the air, and at the same time the humidity may be controlled by partially drying the air. The air of an unventilated laboratory soon becomes saturated with moisture due to respiration and evaporation; and if it be ventilated by allowing hot, moist air from without to enter, the humidity rises as the temperature falls

and the air is unable to carry away moisture generated in the laboratory.

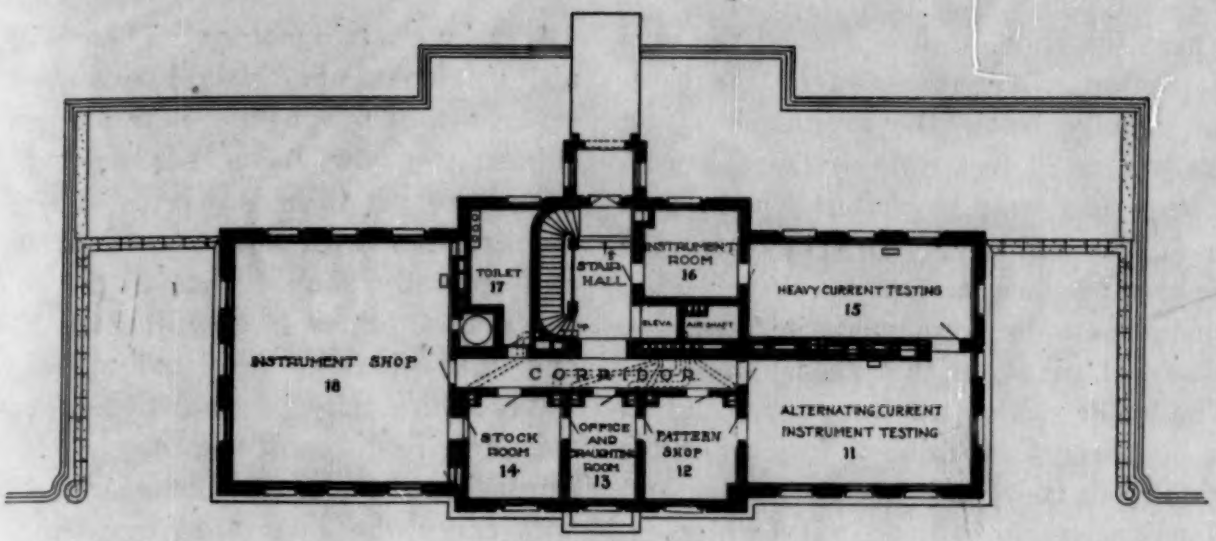
In heating a building by the double-duct system, hot air from one duct is mixed with cooler, tempered air from a second duct in such proportions as to hold the temperature of the room constant, the proportions of the hot and tempered air being regulated by a pair of dampers, the latter being automatically controlled by means of a thermostat. Each room of a building, therefore, has its own supply flue, regulating dampers and thermostat. The latter may be set at any desired temperature within the range of the apparatus. If now in hot weather the hot-air duct of winter carries air taken from out of doors, say at 90° F., and the tempered-air duct carries artificially cooled air, say at 60°, a mixture of the two may give a room temperature of 75° when the temperature would otherwise be 80° or 85°. And the thermostat will adjust automatically the proportions of cooled and uncooled air, so as to hold this temperature constant, thus preventing the usual gradual increase of temperature as the day progresses. By a readjustment of the thermostat any other constant temperature can be secured, provided it is within the range of the system.

Not only will this system make possible automatic temperature control in summer —a most important end in itself—but it will also secure a humidity control. For by cooling air its moisture is partly removed, and by lowering its temperature to the freezing point it is very largely removed. In order to remove as much moisture as possible, it is intended to overcool the air and then partly warm it up again, and this may be done economically by means of a heat exchanger, *i. e.*, air on its way to the cooling chamber gives up heat through a thin metal wall to the overcooled air coming from the cooling chamber; a given refrigerating capacity will thus remove the maximum quantity of moisture, so that the percentage humidity of the air may be no greater at the lower room temperature than, under normal circumstances, it would be at the higher temperature.

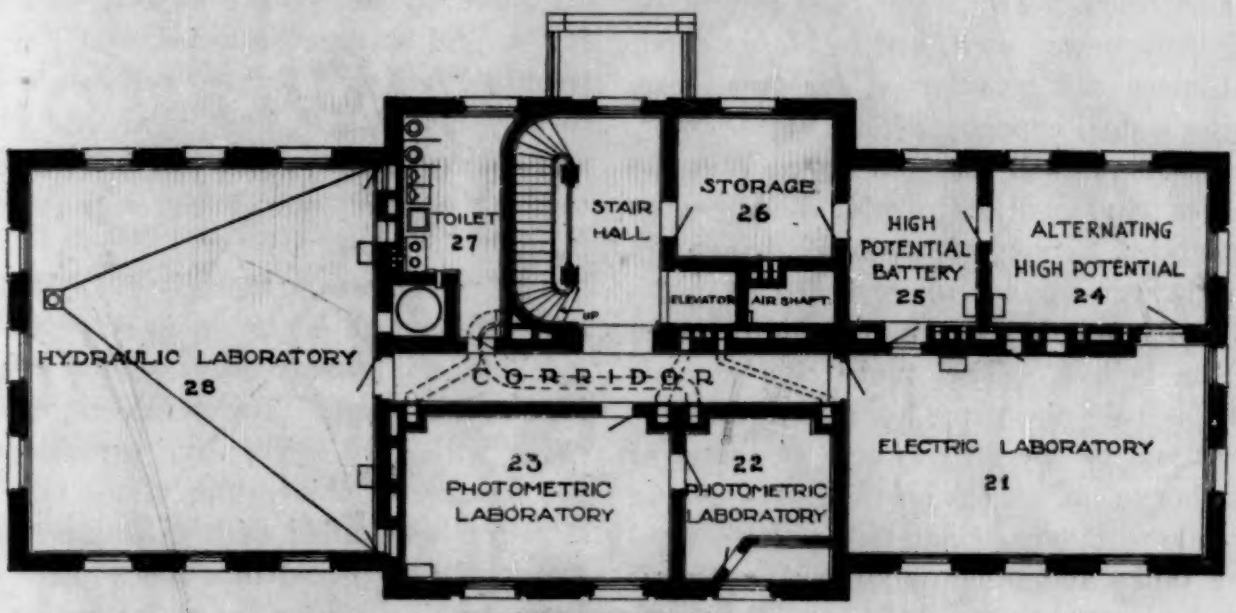
With this system of heating in winter and cooling in summer, with automatic temperature control the year round, with excess of moisture simultaneously removed by refrigeration, and dust from the fresh air taken out by filters, the double windows of the laboratory will be kept tightly closed in summer as in winter, and an atmosphere favorable for experimentation may at any time be secured. The closed double windows will also effectually keep out dust and dirt, two of the enemies of the experimentalist. With gas, compressed air, vacuum, hot and cold water, ice water and distilled water always at hand; with cold brine, carbon dioxide and liquid air always available for low temperatures, and gas and electric furnaces available for high temperatures; with direct electric currents, at potentials up to 20,000 volts and currents up to 20,000 ampères, and still higher alternating voltages and larger alternating currents always available, it is believed that the facilities and appliances necessary for carrying on a wide range of experiments under favorable conditions will be fairly well realized.

THE MECHANICAL LABORATORY.

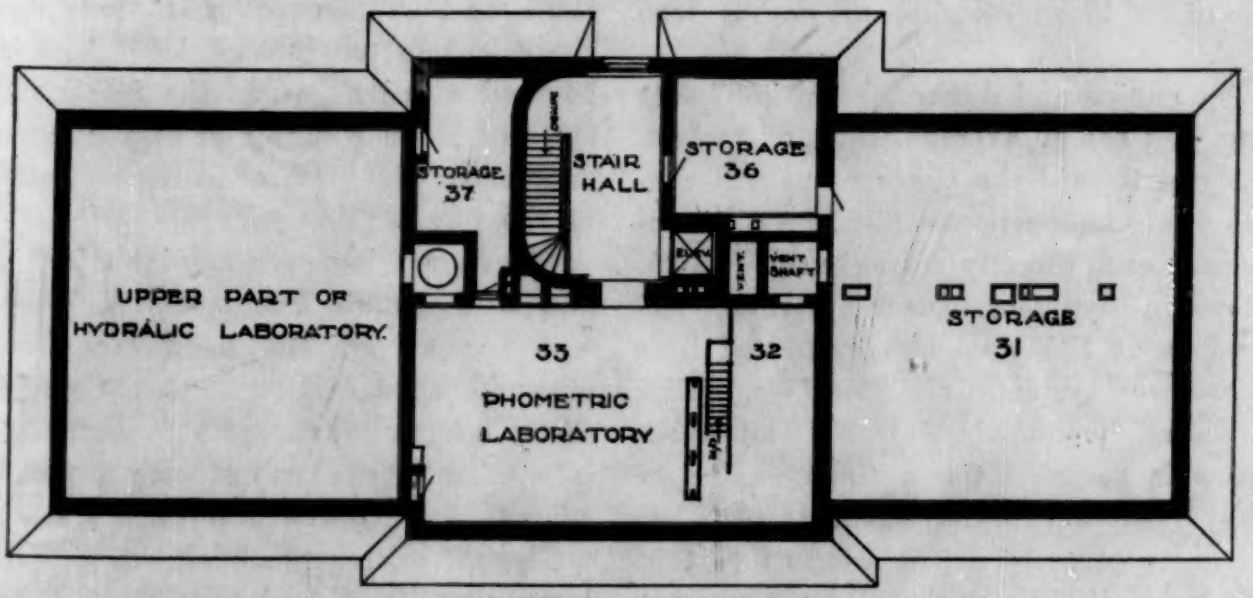
The mechanical laboratory is being built of dark red brick, trimmed with Indiana limestone. It stands on ground sloping toward the north, so that the basement story is wholly above ground on the north, but comes only a few feet above ground on the south. The building is 135 feet long east and west, and 48 feet wide north and



FIRST FLOOR PLAN.



SECOND FLOOR PLAN.



ATTIC FLOOR PLAN.

THE MECHANICAL LABORATORY.

south at the ends, and 58 feet in the central portion. An extension of the basement, wholly below the ground level on the south, is 20 feet wide and projects 25 feet east and west beyond the main portion of the building. This increases the floor area of the basement by 50 per cent., affording ample accommodation for the mechanical plant on this floor.

The boiler room is 42 feet square and 19 feet high, the floor being 5 feet below the engine room floor, and, like the engine and dynamo room, it is lined with white enameled brick. Two water-tube boilers, of 125 horse-power each, are to be installed, and space will be reserved for two other, giving a final capacity of 500 horse-power. The boilers will be fed by automatic stokers, and induced draft will be furnished by a pair of blowers, driven by small steam-engines so governed as automatically to hold a constant steam pressure in the boilers. The smoke flue extends only a little above the roof, and the furnaces will be operated to give as nearly as possible smokeless combustion. Water and air pumps, filters, boiler feed pumps, pressure tanks and other auxiliary apparatus will be located on a platform at the north side of the boiler room, on the engine floor level.

The engine and dynamo room is 87 feet long, and has an average width of 24 feet. The end toward the boiler room will contain two 80-horse-power high-speed steam-engines, each directly connected to two 25-kilowatt dynamos, each giving 200 ampères at 125 volts and connected in a three-wire system, the total capacity, therefore, amounting to 100 kilowatts. Space is reserved for a third engine of 160 horse-power, to drive generators of 100 kilowatts capacity. The western half of this room will be occupied by a number of alternating-current dynamos directly driven by electric motors. These will furnish singlephase and polyphase current for experimental purposes. Several such machines are now being constructed, and others are yet to be ordered. There will be machines with smooth-core armatures and specially shaped pole pieces to give sine waves, others to give distorted waves, and still others to give several harmonic waves which may be combined in various ways to give different wave forms. On the south side of the engine room a switchboard will carry the controlling apparatus for all these dynamos and motors, and also for several storage batteries, and for distributing current to the various laboratory rooms of both buildings. Both live and exhaust steam pipes will be located in the subbasement under the engine room floor.

The refrigerating room is 41 × 18 feet, and will contain an ammonia refrigerating machine, a liquid-air machine, and a small ice-making plant. The refrigerating machine will have a capacity equivalent to the melting of thirty tons of ice per day. A large tank, filled with calcium chloride brine, will be placed in a room in the subbasement just under the refrigerating machine, and will enable 'cold' to be stored equivalent to ten tons of ice. This may be used at night, when the refrigerating machine is not running, or may be used to supplement the machine in the hottest part of the day, if necessary.

The storage battery room is 61 feet long, and will contain several batteries, which will furnish current to motors driving alternators, ventilating fans, the machines of the instrument shop, lights in the buildings when the engines are not running, and current for experimental purposes.

The air-cooling chamber will contain a large quantity of iron pipe through which cold brine will be pumped, and the air to

be cooled will be blown over these coils of pipe. On one side of this cold room, space will be reserved for placing apparatus which it may be desired to cool, or to perform an experiment at the low temperature of this room. The hall in the center of the basement, which is ten feet wide, leads directly into the tunnel, which is twelve feet wide and on the same level. This tunnel leads directly into the basement of the physical laboratory, located about 175 feet to the south. The heating chamber will contain two banks of steam coils, a larger or 'heating' coil, and a smaller or 'tempering' coil. Air passing through the first is drawn into fan No. 1, while air passing through the second goes along the direction of the dotted line into fan No. 2. When it is desired to cool the air, the latter is diverted and goes along the course of the solid arrows through the cooling chamber to fan No. 2. Each fan has a double discharge, about three fifths of the air passing out of the upper outlet, toward the south and through the tunnel to the physical building, and two fifths going through the lower outlet under the floor of the corridor, to be distributed to the flues of the mechanical building. These blowers are operated by electric motors, and may be driven at different speeds.

The gas machine will produce a gas from gasoline better suited for furnace work, hardening, tempering, etc., than ordinary illuminating gas. This will be piped to all the laboratory rooms.

The large room on the first floor, just above the boiler room, is the instrument shop. This is an important feature of any physical laboratory where research is carried on. Four or five lathes of different sizes and styles, a universal milling machine, shaper, drill press, grinder, circular saw and other machines will be installed, and a complete equipment of hand tools provided. The stock room, drafting room, and pattern shop belong to the instrument shop.

At the instrument room on this floor, instruments for testing will be received and shipped, and apparatus and supplies of the bureau will be received. The heavy current testing laboratory will be provided with eight large storage cells, which, when joined in parallel, will give a current up to 20,000 ampères. They will be charged in series, and may be discharged singly or together in any combination. Shunts and recording wattmeters for heavy current will be tested here. The adjacent room, which is directly over the alternating generator, will be used for testing alternating-current instruments. This will sometimes include an examination of their behavior on different loads, at different temperatures, with currents of different frequencies, different power factors, and different wave shapes. Complete specifications of these factors will be supplied when desired with the results of the test.

Immediately above this room on the second floor, is another electrical laboratory room for alternating- and direct-current experiments, and the magnetic properties of iron, study of transformers, condensers, and cables, under relatively high electromotive forces. Room 24, adjacent, will contain transformers for obtaining still higher alternating voltages for testing insulation resistances; and instruments for measuring alternating voltages up to 50,000 volts or higher will be tested here. Room 25 will contain a storage battery of small cells giving potentials up to 20,000 volts and currents up to 1 ampère at this voltage. Rooms 22 and 23 are to be used for the photometric study and calibration of incandescent lamps, gas lamps, Nernst lamps, etc. Immediately above, on the

attic floor, is a large room for arc-lamp photometry. The hydraulic laboratory extends through the second and attic stories, giving a maximum height of over 25 feet. It will be used for testing gas and water meters, pressure gauges, anemometers, steam indicator springs, etc. Provision has been made for a mercury column in the elevator shaft, so that it can be observed from the elevator platform.

Fresh air taken into the building through an open window on the north side of the second floor (adjacent to one of the photometric rooms) passed up to the filters above, then down the air shaft to the heating and cooling coils of the basement, and thence to the blowers.

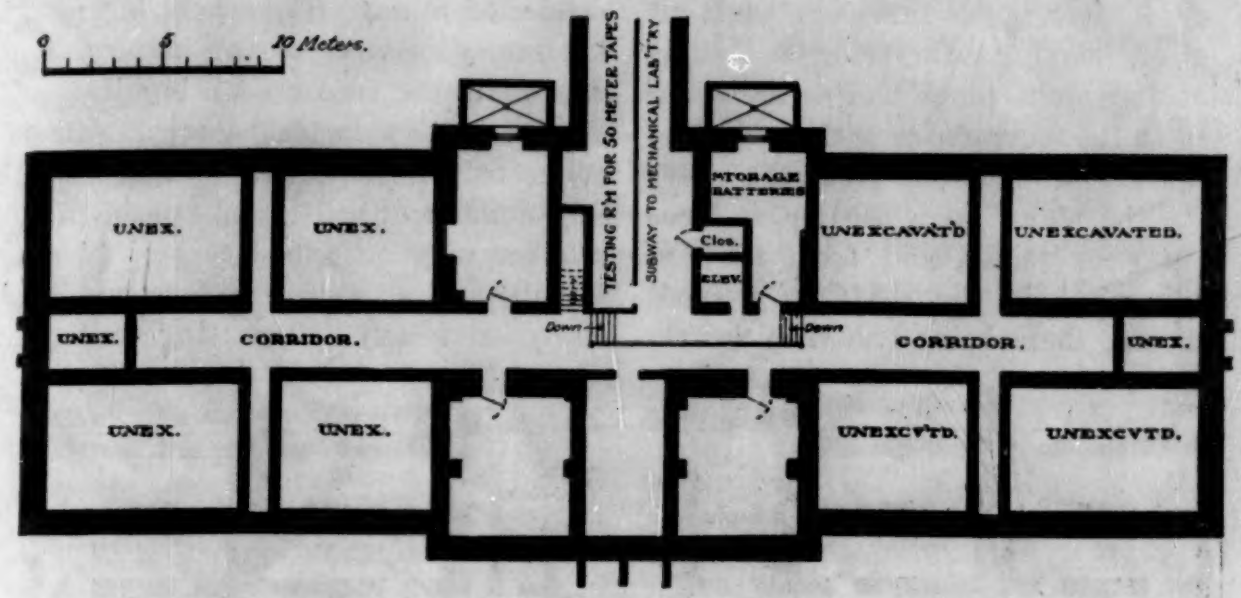
THE PHYSICAL LABORATORY.

The physical building, like the mechanical building, will be built of dark red brick and Indiana limestone, the first story being entirely of stone and the upper stories trimmed with stone. The building is 172 feet long, 55 feet wide, and four stories high, besides a spacious attic story. It faces the south, overlooking the city of Washington.

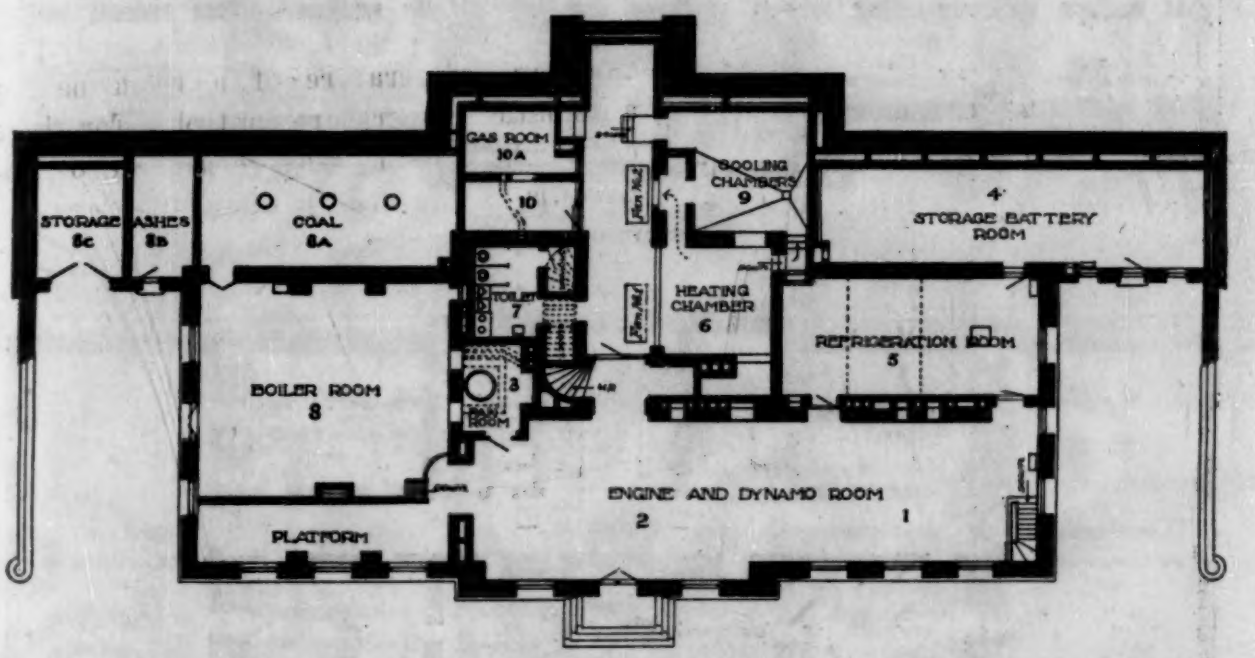
The corridor extends the entire length of the first floor, and the exterior of the building is so designed that if, in the future, additional buildings should be needed, they may be placed one on the east and the other on the west of this building, and connected to it by an arcade opening into the corridor of the first floor. A basement is excavated only under the central portion of the building, and under the corridor, the four large rooms at either end of the ground floor have concrete floors upon which piers may be built as they are found necessary. In one of the basement rooms a storage battery will be installed; the others will be used as constant-temperature rooms for experimental purposes whenever they are needed. Room 4 is a constant temperature room, which will contain the standards of the bureau, and Rooms 13 and 17 are constant-temperature rooms for experimental purposes. All of the rooms of this floor and the floor above, however, will be practically constant-temperature rooms. For with automatic temperature control the temperature can be maintained as nearly constant in these rooms (which have heavy walls and tight double windows) as it could be in any inside or underground room where an observer is working. For the presence of the observer and the heat due to artificial light will disturb the otherwise constant temperature as much or more than the fluctuations in temperature of a room having automatic temperature control. For those cases where a machine or a piece of apparatus is operated without the presence of an observer, as for example a dividing engine, an underground or inside room is better, and several of these have been provided.

A massive-walled, dark, unventilated constant-temperature room is sure to be damp, and is a very poor place for experimental work; there are no such rooms in this building. All of the so-called constant temperature rooms are provided with forced ventilation, although the ventilating air current can be cut off when desired.

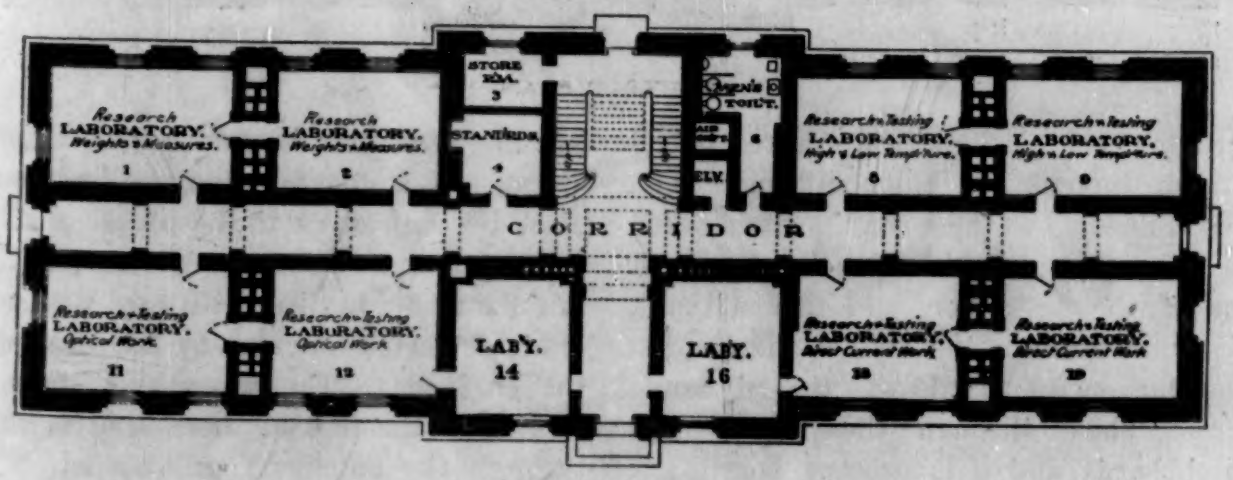
Between Rooms 1 and 2, next to the outer wall, is a vertical shaft three feet square, extending from the basement to the attic, and in corresponding positions are three similar shafts in the other three quarters of the building. All the pipes for distributing gas, compressed air, and vacuum, hot and cold water, ice water, distilled water, cold brine, and all the electric wiring for lighting and experimental purposes are carried up through these



BASEMENT PLAN.



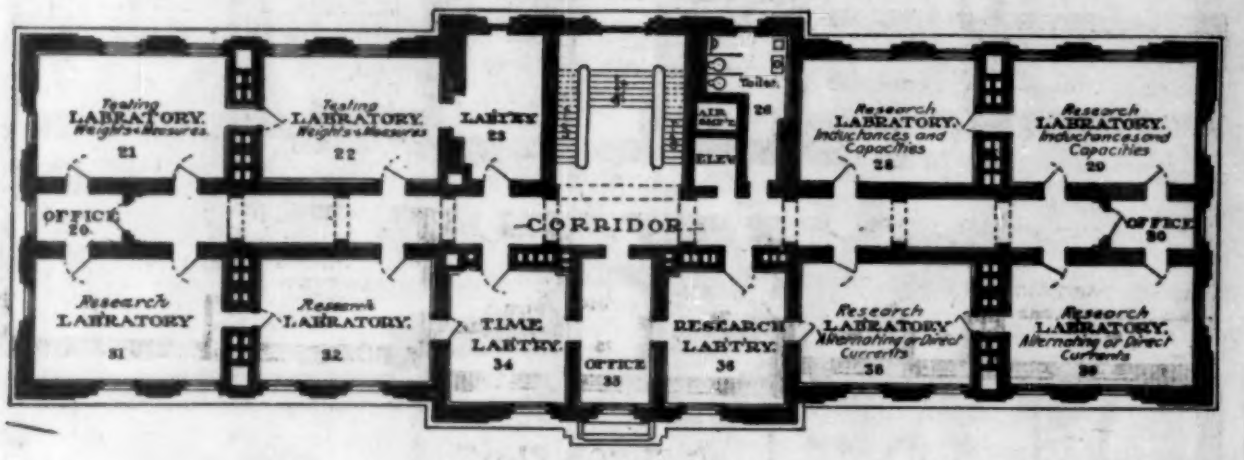
BASEMENT FLOOR PLAN.


STORE RM. 3
Research LABORATORY. Weights & Measures. 1
Research LABORATORY. Weights & Measures. 2
STANDARDS 4
Research & Testing LABORATORY. High & Low Temperature. 6
Research & Testing LABORATORY. High & Low Temperature. 9
ELV.
CORRIDOR
Research & Testing LABORATORY. Optical Work. 11
Research & Testing LABORATORY. Optical Work. 12
LAB'Y. 14
LAB'Y. 16
Research & Testing LABORATORY. Alternating Current Work. 18
Research & Testing LABORATORY. Alternating Current Work. 19

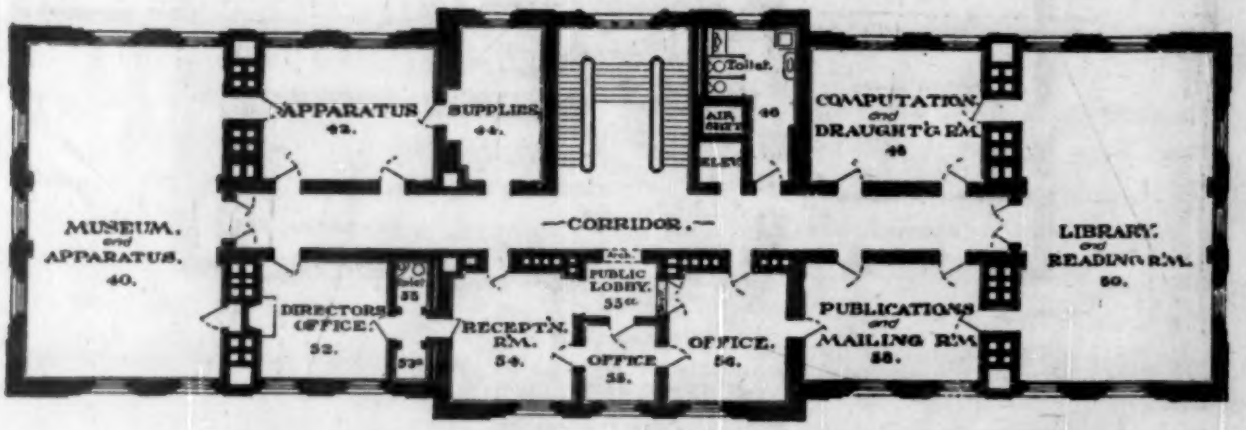
GROUND FLOOR PLAN.

THE PHYSICAL LABORATORY.

shafts. A door opens into each shaft on each floor, making everything accessible without the main pipes and wires being exposed in the laboratories. On each floor branches are brought out from the water pipes to the sinks, from the air and gas pipes to work tables, and from the distributing wires in the shaft to a small switchboard, there being one such switchboard for each suite of two or three rooms in each quarter of the building. The wires connected to these small switchboards run to a main switchboard near the north door of the first floor, and thence trunk lines run through the tunnel to the distributing switchboard of the dynamic room. Thus, through these two main switchboards and a laboratory board any circuit in any laboratory room may be connected to any other circuit in any other laboratory room or to any battery or generator in the mechanical building. The storage battery in the basement will be so connected to the main switchboard that any number of cells from one to the total number may be joined to any laboratory circuit, and an auto-transformer will similarly give any alternating voltage required. Alternating currents of different phases and frequencies may be had at any place by connecting to the proper machine in the dynamo room. An experimenter can then be supplied with any particular kind of electric current by telephoning to the engineer. The pipes and wires are carried to the foot of these vertical shafts through the basement and tunnels which extend under the flues of the partitions



2ND. FLOOR PLAN.



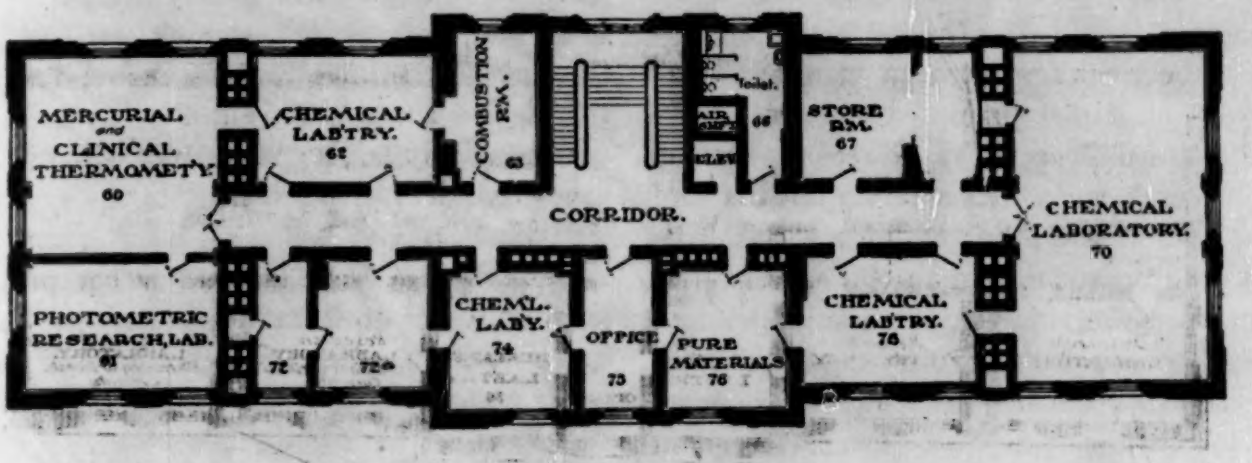
3rd FLOOR PLAN.

between Rooms 1 and 2, etc. Room 1 is 18 × 28 feet, and Room 2 is 18 × 25 feet.

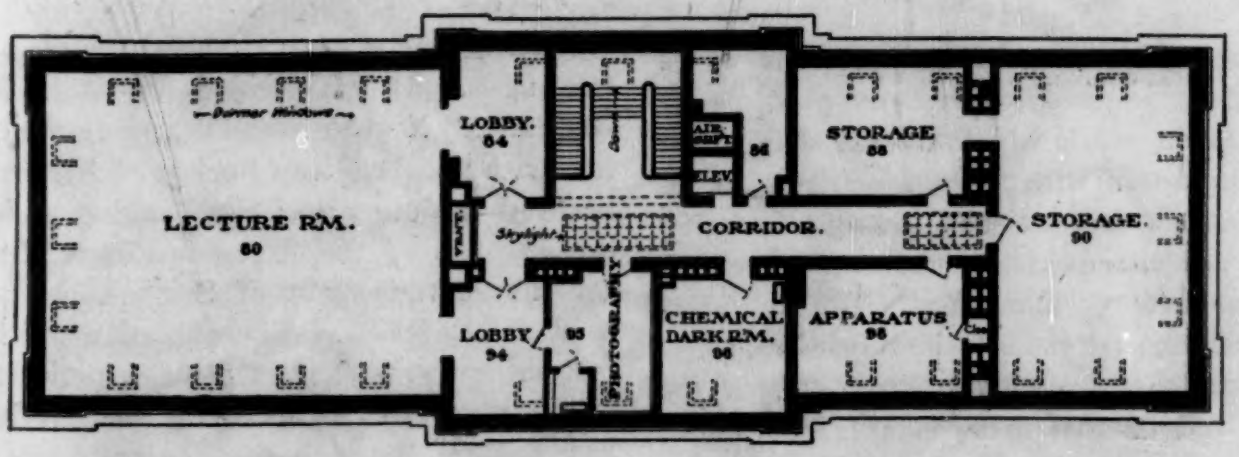
Rooms 1 and 2 will be used as research laboratories for weights and measures, and 21, 22 and 23 will be used for testing weights and measures. This includes masses from a milligram to twenty kilograms, or from a grain to fifty pounds; standards of length up to a meter or a yard; and measures of volume, such as pipettes, burettes, standard flasks, of various capacities up to cubic-foot bottles. Rooms 11, 12, 13 and 14 will be used for research and testing in connection with various methods of making precise mass, length and capacity measurements, including optical methods and optical instruments. Rooms 31 and 32 will be used as general research laboratories, and Room 34 will be used as a laboratory for testing watches, chronometers, clocks, tuning forks and other timepieces.

Rooms 8 and 9 will be used for research and testing of thermometers and pyrometers for measuring temperatures outside the range of mercury thermometers. This will include the use of thermo-couples, platinum thermometers, gas thermometers and commercial pyrometers for high temperatures, such as those used in ovens and furnaces, and of gas, platinum, pentane, toluene and other thermometers for low temperatures down to that of liquid air.

Rooms 16, 17, 18 and 19 will be used for investigation and testing of resistance standards, resistance boxes, and shunts;



4th. FLOOR PLAN.



ATTIC FLOOR PLAN.

standard cells, and instruments used in measuring resistance and electromotive forces. These standards are fundamental to all electrical measurements, and special stress has been laid upon the development of this department.

Rooms 28 and 29 are to be employed for the investigation and testing of standards of capacity and inductance, and for studying problems in which capacity and inductance are involved. Rooms 36, 38 and 39 are to be used for research in other alternating- or direct-current problems.

The third floor provides accommodation at one end for a museum, apparatus and supplies; at the other end for the library and reading room, and in the central portion for the offices of administration. These rooms were placed on the third floor, in order to devote the two lower floors to laboratory purposes—where freedom from mechanical disturbance is of greater importance. The library measures 28 × 48 feet.

Room 61 on the fourth floor is to be devoted to researches on photometric standards, work which will be carried on in connection with the photometric laboratory of the mechanical building. Room 60 will accommodate the work on mercurial thermometers, including ordinary thermometers, precision thermometers, and clinical thermometers. Room 70, at the east end of this floor, is a large general laboratory which may be used for either physical or chemical investigations. The other rooms of this floor will be fitted up as a chemical laboratory, for work in analytical, physical and electrochemistry.

On the fifth floor is to be located a commodious lecture room, which may also be used to some extent as a laboratory; an apparatus room, and two or three storage rooms.

In addition to the heating and ventilating system, in which each room has a flue for supplying fresh air (heated or cooled as the case may be), and a second flue for carrying air away from the room, there is to be a separate exhaust system with a connection to each laboratory room, and also to each toilet room, the storage battery rooms, the hoods of the chemical laboratories, etc. These exhaust flues open down into the basement, where they are gathered into one large duct, which is carried through the tunnel to an exhaust fan in the engine room. This fan will run at a comparatively high speed, and will insure a positive draft at each inlet to the system.

Much thought has also been given to such features of the laboratory equipment as plumbing, work tables, cases, etc., but space forbids giving any particulars.

Edward B. Rosa.

National Bureau of Standards,
Washington, D. C.

AMERICAN PHILOSOPHICAL ASSOCIATION.

Over fifty members attended the second meeting of the American Philosophical Association, held in Washington, in affiliation with the American Society of Naturalists and the other societies meeting under the auspices of the American Association for the Advancement of Science, on December 30 and 31. The affiliation of the association with the scientific societies at this its first meeting following the meeting last Easter, at which it was organized, is significant of the close relation felt to exist between philosophy and the special sciences, a significance emphasized by the fact that a member of the association was this year president of the Society of Naturalists. Probably there was something of the old contempt for abstract speculation on the part of men of science in the good-natured laughter which broke out at the dinner of the naturalists, when it was announced that the psychologists and phi-

losophers were assigned the table at the extreme left of the hall, separating, it was suggested, the philosophic goats as far as possible from the scientific sheep; if so, the laughter might have been turned the other way when, on entering the hall, it was found that the extreme left was at the right of all the presidents of all the scientific societies seated at the high table. Really the present time, symbolized by this affiliation, seems most favorable for mutual understanding and a clearing up of opinion on the important subject of the relations of philosophy and the special sciences. The philosophers, on their part, are now pretty generally agreed that speculation must keep in close touch with experience and with the advances of the natural sciences. Even the most abstract and metaphysical of idealists profess that their systems merely interpret experience, and, as they assume that experience, when properly interpreted, is self-consistent, they too demand that philosophy and science shall be, from the ultimate point of view, one and harmonious, and eagerly endeavor to explain away the glaringly apparent contradictions. Scientists, on the other hand, are becoming increasingly aware of the limitations of their special fields of research and of the purely methodological character of many of their most fundamental hypotheses. A striking illustration of this was given in the Washington address of President Remsen before the Chemical Society, in which, speaking of the atomic hypothesis, he is reported to have said that the conception of the atom had been proved to be illogical, but was, nevertheless, to be retained for the present as a useful device; but as to the dynamics of atoms he frankly admitted that we knew nothing, that they possibly moved in some mysterious way, and that perhaps all chemical phenomena might be due to these motions. There is clearly here little left of the old dogmatism. And as the philosophical aspects of natural science are being more and more recognized by students of philosophy, so, it is to be hoped, the scientific character of philosophy will come to be more and more recognized by men of science. For the function of philosophy is, in fact, largely this, to criticise the categories of science and to develop, from a point of view above that of all the special sciences, the knowledge furnished by every department of experience into a comprehensive science of experience as a whole, *Wissenschaft*, in the large sense of the term.

One of the sessions at the meeting was devoted almost exclusively to one of these aims, the handling, namely, of fundamental conceptions in natural science. Dr. Singer, of the University of Pennsylvania, attempted, in a thoughtful paper, to define the ideal of mechanical explanation; Brother Chrysostom, of Manhattan College, criticised the empirical view of causation; Dr. Spaulding, of Columbia, sought to demonstrate the dogmatic character of the principle, *ex nihilo nihil fit;* and Professor Bawden, of Vassar, defended by new arguments his functional theory of psycho-physical parallelism. At another session questions of a still more general logical nature were discussed, including a critique of cognition and its principles by Dr. Karl Schmidt, of Harvard; an exposition of the function of æsthetic form in judgments of value by Professor R. MacDougall, of New York University; and an examination of logical method in metaphysics by Professor Aikins, of Western Reserve University, the conclusions of the last being decidedly negative as to metaphysics. But the chief interest of the meeting attached to the session of Tuesday afternoon, when the subject, 'What should be our attitude as teachers of philosophy towards religion?'

was discussed by Drs. Miller and Royce, of Harvard; President Patton, of Princeton, and Dr. William T. Harris, of Washington, and to that of Wednesday morning, when the association met with the American Psychological Association and listened to important papers by Professors Münsterberg, Dewey, Ladd, Hibben and Jastrow. For both of these sessions larger rooms had to be secured than those originally assigned to either association. These sessions brought out some interesting differences of view. In the discussion, for instance, Dr. Miller contended that religion and philosophy were entirely independent. Dr. Patton, on the other hand, maintained that religion, if worth anything, is a rational thing and must be rationalized. Professor Royce, in a felicitously worded paper, defined the function of the philosopher in respect to religion as preeminently that of a sympathetic but clear and judicial intellect. The conflicting positions assumed by Professors Münsterberg and Dewey in their papers at the joint session, the conflict having to do with certain aspects of the fundamental question of the relation of knowledge and reality, led to an animated debate in which, besides the principals, Professors Baldwin and Creighton also took part, while Professor Ladd's criticism of psycho-physical parallelism called out a sharp counter-criticism from President G. Stanley Hall. Such discussions are among the most instructive events in a meeting of this sort and exert a decidedly clarifying tendency, even though no very positive result is reached at the time. Without them, papers frequently seem wanting in point, unless they be of such a rarely clear and convincing character as the paper by Professor Hibben, of Princeton, on the philosophical bearings of Ostwald's theory of energetics, or like the address of the president, Professor Ormond, of Princeton, on 'Philosophy and its Correlations,' of which there can be no criticism, but only praise. Of the other papers read at the meeting, it is enough to say that one, by Professor Sneath, of Yale, was on an ethical subject; one, by Professor Horne, of Dartmouth, on the metaphysical aspects of education; two on subjects connected with the philosophy of religion (by Professor French, of Colgate, and Professor Ladd, of Yale), and one a lively criticism of a recent work on personal idealism, the final paper of the sessions, by Professor Caldwell, of Northwestern University. The papers were thus of a very varied character, conducive to the maintenance of interest during the packed four sessions of the meeting, and yet perhaps leaving a somewhat bewildering impression, if there were any one besides the president forced to listen to them all.

One of the most enjoyable features of the meeting was the smoker at the Riggs House immediately following the address of the president on Tuesday evening. The garden of Epicurus could scarcely have afforded a happier combination of philosophical and simply human and friendly social intercourse.

The association elected the following officers for the ensuing year:

President—Professor Josiah Royce (Harvard).

Vice-President—Dr. Edgar A. Singer, Jr. (Pennsylvania).

Secretary-Treasurer—Professor H. N. Gardiner (Smith).

Members of the Executive Committee—Professors William A. Hammond (Cornell) and F. J. E. Woodbridge (Columbia).

The time and place of the next meeting were left with the executive committee.

H. N. Gardiner,
Secretary.

SCIENTIFIC BOOKS.

Dictionary of Philosophy and Psychology. Edited by JAMES MARK BALDWIN, Ph.D. Vol. II. New York, The Macmillan Company. 1902.

In this volume of the 'Dictionary,' the first volume of which was reviewed in Volume XV., No. 373, of this journal, the text of the work is completed. The third and last volume will contain bibliographies. We have very little to add to what has already been said concerning the general character and value of the undertaking. It should always be borne in mind that this dictionary is intended primarily for the student and not for the practised man of research. It aims 'to state formulated and well-defined results rather than to present discussions.' Its worth must be measured by the ideal which it sets itself, and this fact must be kept in view in our criticisms. The question which we shall have to ask ourselves here is, What help does the 'Dictionary' give to persons seeking information?

This question can not be answered indiscriminately, in a word. Some of the articles in this second volume realize their purpose well; others do not. The psychological (normal and abnormal), physiological and general biological subjects are, in my opinion, ably handled. The treatment of the history of philosophy and epistemology is, as a rule, good; it is clear and sound; it does not aim at originality, but bases itself upon standard works. The ethical articles are much better than those in the first volume, though not, to my judgment, fully adequate. The majority of the logical articles are remarkable for their display of historical learning rather than for their utility to the student. They contain a mass of material which one would expect to find in a work like Prantl's 'Geschichte der Logik' instead of in a book like this. Besides, they are often vague, diffuse and polemical, reminding one of the quibbles of the schoolmen, and are not suited to the needs of the persons for whom they are supposed to be intended. The educational articles are few, but their character is not such as to cause one to regret this fact.

The bibliographical material is, as in the former volume, of unequal value. The psychological and biological bibliographies are good, although there is too great a tendency to mention almost every monograph that has been published in the experimental-psychological field. Most of the other bibliographies are not at all adequate. Of course, the third volume may remedy this defect, but the text itself should give the student the greatest possible assistance, and that is not always done, in my opinion. There is no reason why the references under living matter, localization, memory, nervous system, organic selection, optical illusions, reaction time, speech and its defects, spinal cord and vision, for example, should be so full, and those under equally important subjects so very meager. Modern logical books are seldom mentioned; only where the writers of articles are dealing with subjects very near to their hearts, as for example in the case of symbolic logic, do we get satisfactory lists. The educational book-lists are very poor. The habit which some writers have of constantly referring to their own works and even praising them, does not seem to me to be in good taste. I think it would be a distinct gain if we could develop a little more modesty along these lines.

The biographical portion of the 'Dictionary' is the least satisfactory of all. The editor declares in the preface: "And, again, we are not in any way claiming that the treatment of biography is more than the proverbial 'part of a loaf'; it was a question, indeed, of part of a loaf or no bread." But the sins here are not merely sins of omission. Unimportant details are often inserted, and generally no hint is given of what the men described actually stood for. Besides, comparatively unimportant persons are mentioned and important ones left out. We look in vain for such names as Lyell, Machiavelli, Maine de Biran, Mandeville, Marcianus Capella, Karl Marx, Maupertuis, Maxwell, Robert Mayer, Moleschott, Pherecydes, Platner Quintilian, Ratke, Renan, Savigny, Spener, Stirner, Stobaeus, Jeremy Taylor, Tindall, Toland, Tyndall, Vanini, Leonardo da Vinci, Vischer, Whately, Wiclif, Winckel-

mann, but get in their stead: Libelt, J. B. de Mirabaud, Opzoomer, Prevost, Ernst Reinhold, Rothe, Schilling, Schubert, H. C. W. Sigwart, B. H. Smart, Upham, J. Weber, C. Weiss and C. Wright. We cannot expect every one to be mentioned, it is true, but it does seem to me that a biography of Jeremy Taylor, for example, would not have been too dearly bought even if its insertion had made necessary the exclusion say of Upham and Chauncey Wright. Under the rubric 'Philostratus' our attention is called to four Sophists by that name. The most important Philostratus, however, the one who wrote the life of Apollonius of Tyana, in the third century A.D., is omitted.

In addition to the subjects discussed in the 'Dictionary' the following, which are very general in their scope, would not have been out of place: Medieval education, a special article on modern philosophy, modern physical theories, monarchianism, neo-humanism in education, physical culture, primitive christianity, professional education, realgymnasium, realschule, right of sanctuary, school-reform in Germany, secondary schools, social virtues, specialism, sermonism, subordinationism, tolerance, universities, Waldenses. The account of the Renaissance is very meager, but we are referred in it to 'Humanism,' which is also incomplete and refers us back to 'Renaissance.' We are frequently referred to a topic, 'Terminus,' but the topic never turns up. The same statement applies to 'Victorines.' Under 'Preexistence' we are told to look for 'Transmigration.' When we turn to this subject we are sent to 'Metempsychosis.' Still these are minor annoyances, and no dictionary would, it seems, be complete without them.

The statements on page 51: "It (the form) is the result of the development of matter. He (Aristotle) looks upon the problem from the point of view of the naturalist. In particular, the soul is an outgrowth of the body," are, to say the least, misleading. On page 133 ('Nativity') a false impression is given of the dogma of Immaculate Conception. The dogma of immaculate conception which was defined in 1854 does not refer to Christ's miraculous birth at all, but to the immaculate conception of Mary. That Christ was miraculously conceived was accepted almost from the very beginning, but Pius IX. was the first to set the seal of the Church on the doctrine that Mary 'in the first moment of her conception, by a special grace and privilege of Almighty God, in virtue of the merits of Christ, was preserved immaculate from all stain of original sin.'* On page 421 the following sentence occurs: 'Kant terms his philosophy empirical realism, meaning that it holds to an existence of things in space independent of our particular states of consciousness, opposing it to transcendental realism, which asserts that time and space are something in themselves independent of our sensibility.' This does not seem to me to give Kant's meaning correctly. The Plutarch mentioned on page 496 as having died 120 A.D. is not the Plutarch who belonged to the Neo-Platonic school of Athens. The celebrated Plutarch, author of the 'Lives,' died in the neighborhood of 120. Plutarch the younger, the philosopher referred to on page 496, died 433.

The references which are made to other books are not always definite and exact enough. We are frequently referred to passages in Kant's works, for example, but we are seldom told in which one of the many editions the passages are to be found. Where the references are to translations of works, a statement should be made to that effect.

The lack of uniformity in spelling, etc., to which attention was formerly called, is not so great in this volume as in the other. There are, however, a few points which may be mentioned here. We find Localisation, Lokalisation, localisirt; Pharisäertum, Eigentum, Minderwertigkeit, Tatsachen; Socialisierung; Watts's; Kritik, Critique, Critic; Okham, Occam; Abelard, Abélard; Leibnitz, Leibniz; spacial, spatial. French titles are written with and without capitals.

In conclusion, I should like to call attention to the following mistakes: p. 28, for Machina write Maschine; p. 85, for Atomen,

* Translation from Schaff's 'Creeds of Christendom.'

Atome; p. 113, for present, prevent (the passage from Bentham in which this mistake occurs was evidently taken from Eisler's 'Wörterbuch,' where the same mistake is made); p. 126, for Preyer, Preger; p. 143, for Appendix B, Appendix II.; p. 194, for Fonsgriève, Fonsegrive; p. 269, for Kirchener, Kirchner; p. 270, for 1894, 1874; p. 273, for Appuleius, Apuleius; p. 292, for Herbert, Herbart; p. 456, for fühlen, Fühlen; p. 500, for Natur und Grenzen der Naturwissenschaft, Über die Grenzen des Naturerkennens; p. 533, for Gibert, Gilbert; p. 601, for Puffendorf, Pufendorf; p. 668, for stata, states; p. 823, for Nietsche, Nietzsche. The reference on page 421 to Müller's translation of the 'Kritik' (p. 320–326) should, I suppose, be to pages 300 ff.

The Greek, Latin, German, French and Italian indices which are found at the end of the second volume are useful.

FRANK THILLY.

UNIVERSITY OF MISSOURI.

SCIENTIFIC JOURNALS AND ARTICLES.

The Popular Science Monthly for January contains an excellent account of 'The Missouri Botanical Garden,' by William Trelease, telling of its origin, arrangement and plans for future growth. Alfred C. Haddon makes a plea for 'The Saving of Vanishing Data,' mainly zoological, and A. J. McLaughlin combats 'America's Distrust of the Immigrant' with the aid of various tables showing his various deficiencies. 'Variation in Man and Woman,' by Havelock Ellis, is largely a reply to former criticism by Professor Pearson and tends to show that variation is greatest in man. J. C. Sutherland considers 'The Engineering Mind,' and A. L. Benedict makes a plea for 'Post-graduate Degrees in Absentia.' Frederick Adams Woods presents the sixth of his papers on 'Mental and Moral Heredity in Royalty,' the present being devoted to the Bourbons in Spain, and W. J. Spillman discusses 'Mendel's Law.'

IN *The American Naturalist* for December A. W. Grabau presents some 'Studies of Gastropoda' and W. M. Wheeler describes 'The Occurrence of *Formica cinerea* Mayr and *Formica rudibarbis* Fabricius in America.' The twelfth part of 'Synopses of North American Invertebrates' is by H. S. Pratt, and continues the treatment of the Trematodes, embracing the digenetic forms. This is a long and fully illustrated paper. The number contains the index to Volume XXXVI.

The American Museum Journal for January gives notes on the second Cope collection of fossil vertebrates, on the Eskimo collection from Hudson Bay and on the skeleton of the finback whale recently acquired by the museum. The supplement is a substantial 'leaflet' of thirty pages, fully illustrated, devoted to an account, by W. D. Matthew, of the 'Evolution of the Horse.' This pamphlet should be in demand, as it summarizes our knowledge of this subject in a most admirable manner and brings it down to date.

THE leading article of *The Museums Journal* of Great Britain for December is on 'Technical Museums,' by John MacLauchlan, and is a sketch of the technical museum of Dundee, showing how its collections were brought together at comparatively little cost. Not every museum, however, is so favorably located for acquiring material. The bulk of the number is occupied by reviews of museum reports and with notes. From these last we learn that the collections made by Sven Hedin are now in the Stockholm university college, where they are being arranged and studied.

F. A. LUCAS.

SOCIETIES AND ACADEMIES.

OHIO STATE ACADEMY OF SCIENCE.

THE twelfth annual meeting was held at Columbus, November 28 and 29, with about thirty-five members in attendance. The committee on topographic survey reported that the legislature had granted $50,000 to continue the work in cooperation with the United States Geological Survey in 1902 and 1903. Lynds Jones, of Oberlin, gave an account of work done with aid from the Emerson McMillin research fund to secure data for a catalogue of the birds of Ohio to be published by the Academy. C. Judson Herrick was elected president for the ensuing year; J. A. Bownocker and Miss L. C. Riddle, vice-presi-

dents; Herbert Osborn, treasurer; E. L. Moseley, secretary; F. L. Landacre and T. A. Bonser, members of the executive committee; J. H. Schaffner, trustee and member of the publication committee. Hon. Joseph Outhwaite, president of the newly organized Society for the Prevention of Tuberculosis, addressed the academy on the work of that society.

The following papers were read:

HERBERT OSBORN: 'Opportunities for Faunal Studies at the Lake Laboratory at Sandusky.'

F. L. LANDACRE: 'A List of Protozoa Observed during the Summer of 1902.'

MAX MORSE: 'Ohio Batrachians and Reptiles.'

C. JUDSON HERRICK: 'A Note on the Significance of the Size of Nerve Fibers in Fishes.'

W. F. MERCER: 'Report on the Development of the Bones in the Legs of our Domestic Animals.'

JAS. S. HINE: 'The Tabanidae of Ohio.'

JAS. S. HINE: 'A List of Ohio Syrphidae.'

HERBERT OSBORN: 'Remarks on the Occurrence of Periodical Cicada in Ohio in 1902.'

HERBERT OSBORN: 'Note on the Occurrence of the Cigarette Beetle in Columbus.'

MAX MORSE: 'Unusual Abundance of a Myriopod.'

WILLIAM R. LAZENBY: President's Address—'The Dietetic Value of Fruit.'

ROBERT F. GRIGGS: 'New Heliconias from Guatemala and Elsewhere.'

OTTO E. JENNINGS: 'Further Notes on Smut Experiments.'

W. A. KELLERMAN: 'The Life History Problem of the Heteroecious Rusts.'

H. HERZER: 'Eleven New Species of Fossil Plants.'

LUMINA C. RIDDLE: 'Some Algæ from Sandusky Bay.'

W. A. KELLERMAN: 'The Three Forms of Prickly Lettuce in Ohio.'

W. A. KELLERMAN: 'Annual Report on the State Herbarium and Plants New to the State List.'

E. L. MOSELEY: 'Additions and Corrections to the Sandusky Flora.'

JOHN H. SCHAFFNER: 'The Flora of Chicken Island.'

JOHN H. SCHAFFNER: 'Ohio Station for Myriostoma.'

WM. C. MILLS: 'New Discoveries at the Baum Prehistoric Village Site, Ross County, Ohio.'

WM. C. MILLS: 'The Gartner Mound.'

W. A. KELLERMAN: 'Two Botanizing Trips in the Mountains of West Virginia.'

H. HERZER: 'Two Fishes from the Upper Helderberg Group.'

WM. C. MILLS: 'The Darnell Mastodon.'

OTTO E. JENNINGS: 'General Climatic Conditions of Ohio.'

THOS. BONSER: 'Some Problems in Montana Forestry.'

ROBERT F. GRIGGS: 'Three Interesting Tropical Plants.'

W. A. KELLERMAN: 'An Ecological Study of West Mansfield Swamp,' preliminary report.

THOS. BONSER: 'Final Report on Big Spring Prairie.'

LUMINA C. RIDDLE: 'Microscopic Life Forms in Brush Lake.'

JOHN H. SCHAFFNER: 'Preliminary Report on the Plant Ecology of Brush Lake.'

WM. C. MILLS: 'Identification of Flint from the Prehistoric Flint Quarries of Licking County, Ohio.'

E. L. MOSELEY: 'Currents in Sandusky Bay.'

W. A. KELLERMAN and J. G. SANDERS: 'The Ohio Erysiphaceæ—Keys and Distribution.'

LESLIE D. STAIR: 'Additions to the Cuyahoga County Flora.'

LESLIE D. STAIR: 'Additions to the State Flora.'

OTTO E. JENNINGS: 'Trees and Shrubs on the Ohio State University Campus, with Dendrological Notes.'

E. L. MOSELEY: 'The Meteor of September 15.'

JOHN H. SCHAFFNER: 'Report of Progress on the Plant Ecology of Ohio.'

W. A. KELLERMAN: 'Variation in *Carex lurida*.'

E. L. MOSELEY,
Secretary.

NORTH CAROLINA ACADEMY OF SCIENCE.

THE North Carolina Academy of Science held its first annual meeting at Trinity College, Durham, N. C., on November 28 and 29, 1902. Between thirty and forty persons attended the various sessions, most of whom identified themselves with the organization. Retiring President W. L. Poteat, of Wake Forest, gave an admirable address upon the subject 'Science and Life,' after which the Academy was tendered an informal reception by the faculty and ladies of Trinity College. About fifteen papers were presented in full and briefs of several others given, while still others were presented only by title. A resolution was passed authorizing the publication

of the proceedings of the meeting, to include also the constitution and by-laws. The officers for the ensuing year were selected as follows: *President,* C. M. Edwards, Trinity College, Durham; *Vice-President,* C. E. Brewer, Wake Forest College; *Secretary-Treasurer,* Franklin Sherman, Raleigh; *Executive Committee,* Messrs. C. M. Edwards, Franklin Sherman, F. L. Stevens, W. G. Sackett, H. H. Brimley, C. B. Williams, W. L. Poteat, Chas. Baskerville, Collier Cobb.

F. S.

AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION.

THE fortieth regular meeting of the section was held at the 'Tech Union,' Garrison St., Boston, Friday, December 19, at 8:00 P.M., President A. H. Gill in the chair. About 150 members were present. Dr. Carl Otto Weber, of Manchester, England, gave a very interesting talk on 'India Rubber, its Chemical and Technical Problems,' in which he first described the preparation of the gum from the milk as it exudes from the trees when they are tapped, and showed that the coagulation of the milk is influenced by the albuminous matters which are always present. If these substances are allowed to coagulate with the rubber, it is impossible to remove them afterwards, and they become the source of the injurious fermentation which often occurs in crude rubber. Pure rubber free from albuminous matter, even if shipped wet, will not ferment at the extreme heat to which it is often subjected in the holds of vessels, and arrives at its destination in perfect condition. It is thus of the greatest importance to use a process of curing in which the albumen is removed before coagulation.

Dr. Weber then took up the question of the chemical composition of rubber, showing that rubber, freed from albuminous and resinous substances, no matter from what source the rubber is derived, consists of two substances; one, amounting to four per cent. or less of the total, insoluble in all solvents, contains oxygen, and has the empirical formula, $C_{20}H_{68}O_{10}$; the remainder is a hydrocarbon $(C_{10}H_{16})_n$. As to the constitution of this hydrocarbon, it is undoubtedly a polymer with a very high molecular weight. On dry distillation it gives C_5H_8, isoprene, $C_{10}H_{16}$, inactive limonene, and $C_{15}H_{24}$, the so-called heveëne. The last two compounds are cycloterpenes, but isoprene is an open chain compound, with two double bonds, and has the formula,

$$H_2C=C(H)-C(CH_3)=CH_2,$$

or 2-methyl-1, 3-butadiene. Isoprene, on standing, polymerizes into rubber, or polyprene as it has been called on this account. There is evidence to show that isoprene is the main primary product of the dry distillation of rubber, and that limonene and heveene are secondary products derived from the isoprene. Rubber forms addition products with chlorine, bromine, etc.; also extremely interesting compounds have lately been discovered, which are formed by the action of oxides of nitrogen on rubber. These compounds, $(C_{10}H_{16}N_2O_3)_2$ and $(C_{10}H_{16}N_2O_4)_2$, are produced quantitatively from all varieties of rubber, and are soluble in many solvents. They, therefore, furnish valuable aid in the analysis of rubber, and open up a very promising road for the further investigation of its constitution. The fact that rubber is a highly polymerized unsaturated hydrocarbon with an open chain, and probably three double bonds for $C_{10}H_{16}$, shows why all attempts to make rubber by polymerizing those terpenes, $C_{10}H_{16}$, which are known to be cyclo-compounds with only two double bonds have not led to success. Attention was also called to the recent work of Kondakoff, who has obtained a compound,

$$H_2C=C(CH_3)-C(CH_3)=CH_2,$$

or 2, 3-dimethyl-1, 3-butadiene, which is seen to be a methylisoprene. This substance, on standing, was converted quantitatively into a white spongy mass, tasteless, odorless and insoluble in all solvents, which is probably a methyl derivative of rubber, or methylpolyprene. Thus a very important step has been taken in the synthesis of rubber.

The lecturer also discussed the subject of vulcanization, pointing out that it consists simply in the addition of sulphur, no hydrogen sulphide being formed if pure rubber is used. The result of vulcanization not only depends upon the amount of sulphur, the heat and the time, but also on the state of the rubber at the moment of vulcanization. The amount of sulphur may vary from that necessary to form a compound, $C_{100}H_{100}S$, to that for $C_{100}H_{100}S_{20}$. The state of the rubber can be greatly changed before vulcanization, as for instance by manipulation between rollers, whereupon it becomes more plastic and loses in elasticity. This is due to the breaking down of the molecules, $(C_{10}H_{16})_n$, into molecules of lower molecular weight, that is where (n), which may be 100 or more in crude rubber, becomes a smaller number. This is shown by the fact that the rubber becomes more easily attacked by oxidizing agents, and is in many ways more reactive, as is to be expected from a highly unsaturated compound, where the higher the molecular weight the less easily is the molecule attacked by reagents.

Dr. Weber showed how many of the technical problems that continually occur in the rubber industry can be solved by the application of theoretical considerations, and closed with an appeal for workers on this very interesting but comparatively little investigated field of organic chemistry.

Arthur M. Comey,
Secretary.

TORREY BOTANICAL CLUB.

At the meeting of Wednesday, November 26, 1902, Dr. W. MacDougal spoke on some examples of propagation by bulbils. Two kinds of bulbils were spoken of, namely, those which morphologically are stems, and those that morphologically are roots. He exhibited specimens of *Dioscorea villosa* which bore in the axils of the leaves large bodies described as bulbils of the first sort, and *Ranunculus Ficaria* and *Globba Schomburgkii* which had similarly placed bodies, much smaller, however, which were morphologically roots. In any case the bulbils reproduce the plant by germinating after falling to the ground. Drawings of *Lysimachia terrestis* were shown that represented the changes effected in the habit of the plant brought about by being grown in water.

A specimen of the so-called 'wood-rose' of Guatemala was also presented by Dr. MacDougal. This curious malformation is a hypertrophy of a branch of some species of the Leguminosæ and is caused by an unknown species of *Loranthus*.

Dr. N. L. Britton made remarks on the plant conditions and the general plant formations of the island of St. Kitts, British West Indies. The meeting then adjourned to the conservatories, where the members of the club, under Dr. Britton's guidance, examined some of the plants that have recently been brought to the Botanical Garden from St. Kitts.

W. A. Cannon,
Secretary pro tem.

At the meeting of December 9, 1902, the first paper was by Professor A. P. Selby, on 'Culture of the Grape-rot Fungus,' with exhibition of culture-tubes containing its fully developed spore-sacs and spores, derived from pycnospores upon the grape leaf. This fungus has menaced the industry in Ohio, producing rotting of both fruit and leaf.

The second paper, by Dr. H. H. Rusby, was on 'The Flora of the Orinoco Delta,' a delta extending about 200 miles along the sea, and as far inland, if we include the region of rocky islands and deep rocky river-channels in addition to the area of silt-deposits. It is doubtful if the part visited by Dr. Rusby had been botanically explored before his visit. Its characteristic features are:

1. A hill flora which covers islands never submerged, and rocky banks of the river toward the interior; trees and Bignoniaceous vines characterize it. Mounted sheets exhibited (from Dr. Rusby's collecting) included *Spondias*, the hog-plum, *Anona*, the custard-apple, palms of the genus *Bactris*, and representatives of the many large trees (reaching often 100 feet high) as a *Vitex* of the Verbena family and an *Aliberta* of the Rubia

family; also a *Paullinia,* a woody vine; a *Cupania,* of the Sapindaceæ, etc.

2. A river flora, including a marginal flora on periodically submerged banks and a submerged flora upon islands; chiefly a mass of tangled vines. River-bank trees, of which specimens were shown, included a *Cecropia* of the Fig family; and *Inga,* a relative of the acacia, a tree which becomes a mass of flowers frequented by hundreds of hummingbirds. Another tree, *Hecastophyllum,* has its hollow stems always inhabited by myriads of formidable ants with a sting hot as fire. Shrubs of the marginal flora include many with a milky juice, as *Tabernæmontana,* and many gorgeous-blooming species of *Solanum.* Woody vines were largely of the Bignoniaceæ; drinkable water was obtained from one which climbed perhaps 100 feet. Marginal river herbs shown included a *Spigelia,* source of a valuable drug, especially important now that the Spigelia of the southern United States is disappearing. A *Cuphea* with orange flowers made a magnificent display. A *Heliconia* (*H. pendula*) of the Zingiberaceæ, resembles a drooping orchid. *Sphenoclea,* an introduced member of the Lobelia family from India, covered low places. Island trees include several large drupe-bearing species of *Moquilea* and *Licania,* related to our plum, and producing a wood valued there for charcoal-making.

3. Along the setbacks of high-water periods, lakes remain as the water recedes, alternating with partly dried exposed levels, which produce peculiarly dense and terrible swamps. The lakes become covered with vegetation which resembles a meadow at a distance. This swamp flora includes floating and herbaceous aquatics and shrubby thickets like chaparral. Trees occur with roots nearly exposed during the dry season. The swamp flora includes many trees of the Rubia family, with valuable wood; a profusion of shrubby *Lantana* and *Eupatorium;* various vines, as the *Securidaca* of the Polygala family; herbs, as *Jussiæa* of the Onagraceæ, etc.

4. A tidal flora extends some forty miles in breadth along the coast, where the villages are built on piles. The littoral flora at the ocean edge is soon replaced by an inland tidal flora, chiefly of stout fan-leaved palms of different species, from the short spiny palms of the river-margins to the tall smooth palms of the hills.

Dr. Rusby found but few orchids; two exhibited were a beautiful *Ionopsis* and a *Habenaria* of curious floating habit, growing where the water beneath was fifteen feet deep. One of the palms occurring there is remarkable for its elevated base, raised about four feet by means of spiny outward stilts (roots?); its smooth trunk rises upward about forty feet.

In answer to inquiries, Dr. Rusby said that his collections were made during six weeks, beginning in April; that though he found many flowers, he concluded that flowering and seed production at any time is comparatively the exception in the tropics, nature relying chiefly on the continuance of plants by vegetative processes. Much of the country visited was uninhabited; the Imataca Mountains, about twenty-five miles distant, had never, it would seem, been visited even by the Indians of the region. Dr. Rusby attempted to penetrate through the twenty-five miles of swamp in vain, making but nine miles in three weeks, and then turning back exhausted with forcing his way over the swamp water. Two of his men, with boards fastened to the feet somewhat in the manner of snowshoes, afterwards crossed the swamps to these mountains, and were rewarded by the discovery of a 'lace-work fall' hundreds of feet in height, but from inaccessible cliffs.

The evening's program closed with the exhibition by Dr. Underwood of a sterile mycelium of a fungus of the nature of a *Polyporus,* growing recently beneath the new North German Lloyd docks.

EDWARD S. BURGESS,
Secretary.

COLUMBIA UNIVERSITY GEOLOGICAL JOURNAL CLUB.

November 21.—Professor J. F. Kemp reviewed 'Etude sur le Point de fusion des mineraux et sur les consequences petrographiques,' par A. Brun. He then reviewed an unpublished paper by Professor W. C.

Knight and himself on the 'Leucite Hills of Wyoming.' This joint paper was given at the Washington meeting of the Geological Society of America.

December 12.—Dr. Julien reviewed a paper in a late number of the *Bulletin de la Société Belge de Geologie* on the origin of the curious granite enclosed in the arkose of the St. Etienne coal basin.

Professor Grabau presented a very interesting paper on the origin of limestones. This was presented at the Washington meeting of the Geological Society of America.

H. W. Shimer.

DISCUSSION AND CORRESPONDENCE.

FIRST RECORD OF THE POLLACK WHALE (BALÆNOPTERA BOREALIS) IN THE WESTERN NORTH ATLANTIC.

To the Editor of Science: I am in receipt of reliable information that during the season of 1902 four finback whales of a species corresponding to, or identical with, *Balænoptera borealis* Lesson were taken at the whaling station at Rose-au-Rue, Placentia Bay, Newfoundland. This is the first authentic record of this form of finback in the western North Atlantic. The species is called 'Sejhval' (pollack whale) by the Norwegian whalers. Whether the species taken at Newfoundland is really identical with the European species can of course only be determined by examination of specimens.

The species named *B. tuberosa* by Cope, on the basis of a specimen killed in Mobjack Bay, Virginia, may be the same as the Newfoundland pollack whale, but the description of that species is inadequate for a positive determination, and the whereabouts of the type is at present uncertain. It is quite as probable that the Mobjack Bay whale represented *B. physalus* L.

The Newfoundland whale fishery, which was established in 1898, has grown to large proportions. The kinds of whales taken are the humpback (*Megaptera nodosa*) and three species of finbacks, namely, the common finback (*Balænoptera physalus* L.), the sulphur-bottom (*B. musculus* L.) and, as just noted, the pollack whale (*B. borealis*, or an American representative of that species).

According to the figures kindly placed in my hands by Dr. L. Rissmuller, more than 450 whales were taken at the Newfoundland stations during the season of 1902. The number of each kind taken at four of the stations was as follows:

Station.	Sulphur-bottoms.	Common Finbacks	Pollack Whales.	Humpbacks.	Total.
Snook's Arm Station*		79		21	100
Balena Station†.....	65	31		11	107
Chaleur Station†.....	60	11		6	77
Rose-au-Rue Station†.	5	70	4	9	88
Total.....	130	191	4	47	372

The fifth station, at Aquaforte, took about 100 whales, mostly humpbacks.

The existence and importance of this fishery are as yet not widely known in the United States. Thus, in the latest number of the *American Museum Journal* (January, 1903, p. 10), in a notice of a probable sulphur-bottom, it is stated that "whalers know this species as the 'finner' or 'finback' (*B. musculus*) and do not prize it, on account of the small amount of blubber and the small size of the whalebone it carries." When it is considered that a sulphur-bottom whale is worth about $1,000 it becomes evident that this statement is hardly warranted.

Frederick W. True.

U. S. National Museum,
January 6, 1903.

A SECOND BISHOP'S RING AROUND THE SUN AND THE RECENT UNUSUAL TWILIGHT GLOWS.

To the Editor of Science: A glare around the sun merging into a faint smoky red or purple ring 5° to 10° wide, with the maximum color about 30° from the sun, has been observed here during the past two weeks. Mr. Rotch noticed a smoky ring around the sun on one day in August but no further unusual glare or color was noticed around the sun

* East coast.
† South coast.

until recently. I first noticed it on the afternoon of December 28 about half an hour before sunset, when it formed a purple ring, or partial ring around the sun, with the maximum color about 30° from the sun. The following note, made on January 9, gives a description as well as I can of the ring as it appears at present.

January 9.—At 9 to 10 A.M. yesterday morning and again at 10 A.M to-day the ring around the sun resembling a faint Bishop's ring was visible. [Bishop's ring was the name given to the ring observed around the sun after the Krakatoa explosion in 1883.] At 10 A.M. a whitish glare surrounded the sun out to about 20°, when it showed a ring of slightly yellow light; outside of this, at a distance of 25° to 30° from the sun, was a ring of faint smoky red or purple light visible out to a distance of about 40° from the sun. From 11 A.M. to 2 P.M. the colors were not visible, but only the whitish glare. At 3 P.M. a faint red or purple again became visible on the outer edge of the glare and grew more distinct as sunset approached. At 4:27 P.M., about two minutes before sunset, the glow seemed to form a broad purple ring about 7° wide and with its maximum intensity about 40° from the sun. At this time, and for several minutes after sunset, the matter causing the glare was visible as whitish striæ within the purple circle, resembling thin cirro-stratus clouds or cirrus haze. The striæ or ripples extended in a north and south direction. [Observations with a nephoscope on the two succeeding days showed that they were moving very slowly from WSW.] Outside this circle of glare around the sun the sky was blue all day without a sign of clouds. After sunset the colored ring became a deeper purple and approached the horizon. At 4:45 P.M. the maximum color was about 25° altitude and there was a fine purple twilight arch in the east. At 4:50 P.M. there was an orange glow on the horizon about 5° wide, as there had been since sunset, and above this was the greenish-yellow ring of striated cloud matter, while above this latter was the outer ring now developed into a bright purple afterglow, extending from about 10° to 25° altitude. At 4:56 the afterglow had partly merged with the glow on the horizon, forming a bright orange glow extending to an altitude of about 13°. After this time the outer edge of the glow gradually approached the horizon, and there was more red in the color. At 5:10 P.M. the glow was about 4° broad and a faint purple tertiary glow was visible with a maximum of brightness at an altitude of about 20°. At 5:15 P.M. this glow was brighter, with a maximum about 15°, while the glow on the horizon was becoming fainter. At 5:20 P.M. the tertiary glow was still visible with a maximum about 10°. After this the color in both glows waned, and all color disappeared from the western horizon about 5:37 P.M.

The sunsets are less brilliant now than they were in November and December, when they reached their greatest brilliancy. On the clearest days during these months the sunset color lasted from an hour and twenty to an hour and thirty minutes after sunset. The maximum brightness and duration was somewhere near the first of December. The succession of colors in the sunsets on clear days has been as follows: (1) An orange glow on the horizon immediately following sunset, lasting twenty to thirty minutes; (2) a purple arch which appeared a few minutes after sunset high up in the sky, with its maximum brightness 30° to 45° above the horizon. As this glow approached the horizon it increased very much in brightness and became more red, usually reaching its maximum brightness about 25 minutes after sunset at an altitude of 10° to 15°, but sometimes continuing to increase in brightness until it reached the horizon, about 35 minutes after sunset; (3) a second faint purple glow which appeared about 40 minutes after sunset between 20° and 50° altitude, and reached the maximum brightness about 50 to 55 minutes after sunset at an altitude between 10° and 20°.

The following note made on December 6, 1902, is typical of the observed changes.

December 6.—4:12 P.M., sunset; 4:20 P.M., orange glow on horizon, faint purple glow over most of the western sky down to about 15° of the horizon; 4:25 P.M., bright yellow-red,

or orange, on horizon, purple glow getting somewhat brighter; 4:30 P.M., orange glow continues on horizon, the afterglow has changed from purple to pink and is much more brilliant, extending to within 7° of the horizon, maximum brilliancy about 15° altitude; 4:35 P.M., the orange glow continues on the horizon, maximum brightness of the afterglow about 10°; 4:40 P.M., orange glow on horizon growing fainter, the maximum brightness of the secondary glow is at an altitude of 7° and is growing somewhat fainter; 4:45 P.M., primary joined to secondary glow and forms a bright orange band about 6° wide on horizon; 4:50 P.M., bright red band about 3° wide on horizon, with here and there short streams extending toward zenith, a faint purple tertiary glow has appeared at an altitude of about 45°; 4:55 P.M., red glow about 2° wide on horizon, tertiary glow brighter and extending from altitude 20° to zenith, maximum about 40°; 5:00 P.M., tertiary glow bright, with maximum about 20°; 5:05 P.M., red glow on horizon fading, purple tertiary glow still bright, with maximum about 15°; 5:10 P.M., tertiary glow fading, maximum about 10°; 5:10 P.M., reddish glow about 5° wide on horizon lasting until 5:25 P.M., when it began to fade rapidly; 5:30 P.M., red band on horizon about 1° broad and growing faint; 5:35 P.M., reddish glow still visible; 5:40 P.M., glow gone.

The duration of these sunsets was considerably longer than the normal sunsets, and it is probable that they were due to the dust from the West Indian volcanoes.

Henry Helm Clayton.
Blue Hill Meteorological Observatory.
January 11, 1903.

SHORTER ARTICLES.

SOME CORROSIONS FOUND ON ANCIENT BRONZES.

At the suggestion of Gen. C. G. Loring, of the Boston Museum of Fine Arts, I undertook, some years ago, the investigation of various corrosions appearing on ancient bronzes. The large collection of Grecian and Egyptian bronzes in the Boston Museum furnishes sufficient variety to make the observations of general value. The results obtained may, therefore, be of interest to collectors and curators of other museums.

The ordinary dark green corrosion or *patina* familiar to every one, and most commonly observed on bronze statues exposed to the weather, consists of basic copper carbonate and is comparatively harmless. On very old statues, especially if they have been buried, two different corrosions have been noticed, which from their appearance may be designated as the *pale blue* and *pale green* excrescences. As will be seen later, both may endanger the life of the bronze, and especially the pale blue is the seat of an active chemical reaction.

The *pale blue* excrescence occurs in blotches all over the surface of the bronze and is especially noticeable in less exposed parts, such as indentations or cavities. It has a very fine powdery appearance and, on account of the ease with which it seems to spread from one bronze to the other, was supposed to be of bacterial origin.* A chemical analysis, however, indicates a different origin of the corrosion. About a gram of the substance was carefully collected and found to consist of 50 per cent. sodium carbonate, 25 per cent. copper carbonate, 25 per cent. sand and a trace of sodium stannate. The large percentage of sodium carbonate leads to the following theory as to the origin of the blue rust: As long as the bronze lay buried in the dry Egyptian soil, no reaction took place; on exposure to a moist atmosphere, however, some moisture condensing gave the carbonic acid of the air a chance to combine with the sodium carbonate, forming acid sodium carbonate. This then attacks the metal, forming copper carbonate and regenerating the sodium carbonate, which combines with the copper carbonate to form a double salt, thus accounting for the blue color. It is easy to see how in the course of time a large amount of metal may be thus corroded. To test the above hypothesis a fresh piece of bronze and some powdered sodium carbonate were exposed for several months to a warm, moist atmosphere. The pale blue excrescence appeared and was identical in all respects with the original rust col-

* Dr. Wm. Frazer, *Nature*, 1898, May 19.

lected from the statuettes. The pale blue rust can be best removed as follows: The statuette is immersed in a bath of hot water and live steam passed in for one hour to keep the temperature up to 100° C. The sodium carbonate is thus completely dissolved, the blue color changing to black as the sodium carbonate goes into solution. Careful brushing from time to time facilitates the process. After about one hour's treatment the metal is exposed and the rust completely removed. The dark green patina is not at all altered by this treatment. Any loosely adhering fragments of stucco can easily be preserved by exercising a little ordinary care.

The *pale green* excrescence resembles the pale blue in almost every particular except the color. It occurs in patches or layers sometimes several millimeters in thickness, and can be distinguished from ordinary patina by its lighter color and more powdery appearance. On chemical analysis it was found to contain no sodium carbonate and to consist mainly of copper carbonate. The removal of the pale green corrosion is much more difficult and liable to damage the statuette. With care, however, the following method gives good results: The bronze is immersed in a hot solution of five per cent. caustic soda for several minutes. The green color immediately turns to blue and the rust is loosened sufficiently to be removed with a dull instrument. Alternate treatment with the alkali and mechanical scraping will finally remove all of the corrosion. All of the alkali must now be removed by careful rinsing, and if necessary with a very dilute solution of hydrochloric acid. The dark green patina is also removed by this process and an ancient statue may acquire an undesirable appearance of newness.

The desirability of cleansing the bronzes at all must also be considered. In the case of the pale blue corrosion this seems necessary, as considerable quantities of metal can be destroyed by the action of the sodium carbonate. In the case of the pale green the destruction of the metal does not take place as rapidly, and other factors must be considered. If the bronze is to be used as a show specimen it is better to leave it unchanged in its antique appearance. For purposes of study, however, a complete cleansing of the surface is necessary, as tracings and engravings have often been exposed which otherwise might not have been revealed. After cleansing the statues should be kept as much as possible in a dry atmosphere. Statuettes in the Boston Museum cleansed by the above methods and placed in air-tight cases have not again become corroded. Some implements are made of very thin metal, and the removal of the thick layer of corrosion would leave too thin a shell. Such cases must be individually considered, and it is better not to place the responsibility of cleansing valuable bronzes in unreliable hands.

WALDEMAR KOCH.

CHICAGO, ILL., September, 1902.

NOTE ON THE CIRCULAR SWIMMING OF SAND-DOLLAR SPERMATOZOA.

WHILE studying artificial parthenogenesis in the sand-dollar (*Echinarachnius parma*) during the past summer, the writer independently observed that when the spermatozoa of this species are placed in a drop of sea-water on a slide they nearly or quite all gather at the upper and under surfaces of the drop and move there in circles. As seen from above, those at the upper surface move in a clockwise direction, and those at the under surface in a counter-clockwise direction. That is, since the head of the spermatozoon is directed towards the surface of the water, considered from its position the motion is always counter-clockwise.

This motion is so common as to seem at times to be universal, and it occurs without regard to the presence or absence of a cover-glass above the drop. The circle is approximately constant in size, having a diameter of about the length of the spermatozoon.

This attraction of the spermatozoon to the surface of the drop apparently shows it to be strongly stereotropic. Two possibilities suggest themselves as explanations of the circular motion. One is that the spermatozoon is differentiated in two planes, so that it has what may be called dorsal, ventral, right and left

sides. We may then say that the dorsal side of the spermatozoon is always directed toward the surface of the drop and that its body is bent or curved toward the left. The second possibility is that the condition here is the same as that described in certain insects by Ballowitz,* who considers the circular motion as a modification of the normal spiral motion which these spermatozoa have when in the middle of the fluid. Being at the surface, further progress in that direction is impossible.

Besides the above-mentioned article by Ballowitz, Dewitz † has described circular motion in the spermatozoa of *Periplaneta orientalis* and other insects, and Düngern ‡ and Buller § have found this phenomenon in all classes of the Echinodermata. Buller's paper, dealing with this subject in some detail and including a study of closely allied species, makes any further account of my observations an unnecessary repetition. It is to be hoped, however, that more careful studies on the structure of the Echinoderm spermatozoon will throw some light on the cause of this interesting phenomenon if, as seems probable, it be structural.

G. M. Winslow.
Lasell Seminary, Auburndale, Mass.,
December 23, 1902.

* *Zeitschr. f. wissen. Zool.*, Bd. L., 1890, p. 393.

† *Arch. f. die gesammte Physiologie*, Bd. XXXVIII., 1886, p. 358.

‡ *Centralbl. fur Physiologie*, Bd. XV., April, 1901, Heft 1.

§ *Quart. Jour. Mic. Sci.*, Vol. 46, Pt. I.

NOTES ON ENTOMOLOGY.

The question of the interpretation of the mouth parts of Diptera has long been a bone of contention among entomologists. Mr. Walter Wesche in a recent article‖ has furnished some additional light on the subject. The author found, by examining the cibarian structure of various flies, that in a few forms there are distinct, though small, projections arising from the proboscis near the base of the hypopharynx. He considers them as 'rudiments' (vestiges) of palpi. They are quite prominent in species of *Hyetodesia, Spilogaster* and *Hydrotea;* and more or less distinct in many Anthomyidæ, Sarcophagidæ, Borboridæ and Sepsidæ, and even in the common house-fly. The position of these palpi indicates, according to the author, that they are maxillary. Therefore, the large palpi of Diptera are labial, and the proboscis is not formed by the union of the labial palpi. The author appears to be ignorant of Dr. Smith's work on the same subject, in which he records two pairs of palpi in the Tabanidæ. Both authors, however, agree that the proboscis is not part of the labium.

The third volume of Mr. Tutt's 'British Lepidoptera' has been issued.* It is a volume of nearly 600 pages, much of it in fine print. Like the other volumes, its most remarkable feature is the labyrinthine wealth of technical detail. All that has ever been published on British Lepidoptera has been carefully studied, and everything that could be of the slightest interest is reproduced here. This third volume treats of but thirteen species, several species occupying over twenty-five pages, and one, *Lasiocampa quercus,* more than sixty pages. Although the work deals with British insects, the amount of matter on biological subjects is so great that the book can but be of immense interest to all concerned in the study of Lepidoptera.

Professor R. Blanchard has given an interesting review† of the poisonous punctures of certain Hemiptera. He records the finding of an Anthocorid, *Lycotocoris campestris,* in a bed in Liverpool, and a large Reduviid, *Rhodnius prolixus,* that at times attacks man in the United States of Colombia. The latter is known locally as the 'Bichuque.' He summarizes what has been written on the 'kissing bugs' of the United States, and adds some European cases of the punctures of *Reduvius personatus.*

Articles on mosquitoes are now quite the

‖ 'Undescribed Palpi on the Proboscis of some Dipterous Flies, with Remarks on the Mouth Parts of Several Families,' *Trans. Roy. Micr. Soc.*, August, 1902, pp. 412–416, 2 pls.

* 'A Natural History of the British Lepidoptera,' Vol. III., London, July, 1902.

† 'Sur la piqûre de quelques Hémiptères,' *Archives de Parasitologie*, V. (1902), pp. 139–148.

thing. Among many recent ones may be mentioned one by Henri Polaillon.* There are chapters on morphology, anatomy, biology, classification and descriptions of French species, malaria, filariasis, yellow fever and prophylaxis. The author has done a considerable amount of work, especially on internal anatomy, but (as a rule) it simply confirms previous statements.

The specialist who cannot resurrect some long-forgotten name from the mouldy tomes of science to replace a well-known and established name is indeed behind the times. The craze to place our nomenclature on a stable basis is resulting in discoveries comparable only to those made in recent archeology. With the coming of each new periodical from Europe we wonder what old friend is now lost in the bog of synonymy. Walsingham in Microlepidoptera, Kirkaldy in Hemiptera, Oudemans in Acarina, Cambridge in Araneida, and Cockerell in the Coccidæ have been tossing genera hither and thither in a most dazzling fashion. Now Krauss investigates the Orthoptera,† finding (as La Porte and Westwood knew) that even the name of the order falls, a synonym of the older Dermaptera. Among other changes, the old family Acridiidæ becomes Locustidæ; *Locusta* Linn. replacing *Acridium* Latr.; while *Acrida* Linn. dethrones *Truxalis* Fabr., and *Acrydium* Fabr. supplants *Tetrix* Latr. The old family Locustidæ becomes Tettigoniidæ; and *Acheta*, replacing *Gryllus*, turns the family Gryllidæ into Achetidæ. The great pity with all of this reforming is that so much of it is correct.

In Part II. of a new publication‡ Dr. Franz Stuhlmann has an article on the tsetse fly (*Glossina morsitans*) and its connection with the 'Surrah' disease of Africa. This disease, which is fatal to many domestic animals, is known in South Africa to be transmitted by the tsetse fly. The life-history of the parasite is not yet known, but it is supposed to pass certain stages within the fly. The tsetse fly, as Stuhlmann states, is closely related to the common stable fly (*Stomoxys calcitrans*), and he gives the life history of the latter insect as probably being similar to that of the tsetse fly. The author compares the various species of *Glossina*, and records finding *G. tabaniformis* in East Africa. He suggests the various lines of investigation that should be followed to discover means of fighting the disease.

The government of India has published a paper on forest insects by Professor E. P. Stebbing, Forest Entomologist of India.* It is illustrated by six plates drawn by a native artist. Fifty-two species are treated; a description, life history, nature of damage, and suggestions for control. Most of the injurious species are Lepidoptera, and among them we note *Agrotis ypsilon* and a number of forms closely allied to the gypsy moth. Three species of Coccidæ of the genus *Monophlebus* are new.

The second part of Kertész's catalogue of the Diptera of the world has been issued. It treats of the families Cecidomyiidæ, Limnobiidæ, Tipulidæ and Cylindrotomidæ. There is also a list of the Cecidomyiidæ according to the plants that serve the larvæ as food. He uses *Cecidomyia* for the species previously called *Diplosis*.

Yellow Entomology.—The popularization of science has gone a long way, but Mr. Harvey Sutherland in the 'Book of Bugs'† has carried it beyond all previous records. The book treats of the insects most common about the house and yard. It is replete with many interesting actual facts, and contains few serious misstatements (such as *Vedalia* eating San José scale). But all these facts are so thickly sugar-coated with humor and nonsense that it will be difficult for the lay

* 'Contribution a l'histoire naturelle et médicale des Moustiques,' Paris, 1901, pp. 128, 22 figs.

† 'Die Namen der ältesten Dermapteren (Orthopteren) Gattungen und ihre Verwendung für Familien- und Unterfamilien-Benennungen auf Grund der jetzigen Nomenclaturregeln,' *Zool. Anzeiger*, 1902, pp. 530–543.

‡ Bericht über Land- und Forstwirtschaft in Deutsch-Ostafrika,' Bd. I., heft 2 (1902).

* 'Departmental Notes on Insects that affect Forestry,' No. 1, pp. 149, Calcutta, 1902.

† 'The Book of Bugs,' New York and London, 1902, pp. 223, 41 figs.

mind to distinguish fact from fancy. Since much of it evidently is not so, the tendency of the average reader will be either to disbelieve everything that seems improbable, or else with child-like faith to swallow both Jonah and the whale. That the facts of nature should be presented in a pleasant and attractive form will be admitted by all, but for this purpose it is not necessary to adopt the style of the comic weekly. It tends to discredit the facts. The author has been very careful in his selection of matter, but his treatment will not, we think, develop a popular interest in insects.

Nathan Banks.

BOTANICAL NOTES.

PHARMACOGNOSY.

In this department of botany, which is scarcely entered by professional botanists in America, there should be found opportunity, as in Europe, for that critical study of cells and tissues which so delights a certain class of students. We have sometimes felt that professors in German universities were to be envied because of the easy way they have of putting a dull student at work on some root or bark, expecting no more from him than a year or two of patient sectioning, drawing and describing. The work is original, and yet there is no danger that the inexperienced and really incompetent student will attempt to make any generalizations, nor that he will ask his instructor to help him make certain 'conclusions.' We are reminded of all this by a volume entitled 'A Course in Botany and Pharmacognosy; by Professor Kraemer, of the Philadelphia College of Pharmacy, which has just appeared. The book was written 'to meet the individual needs of the author in his work as a teacher of botany and pharmacognosy,' and as such is worthy of serious attention. Any book which is the outcome of a successful teacher's experience is a contribution to the pedagogics of the subject with which it deals, and on that account, if on no other, should be of interest to every teacher or student of that subject. Professor Kraemer's book apparently embodies his solution of a problem in pedagogics, and apparently the problem is how to give the student of drugs enough knowledge of botany to enable him to study dried roots, stems, leaves, etc., with sufficient intelligence to make it worth his while to do the work. We confess to not liking this way of preparing a student for his work by a 'short cut' in botany, but no doubt the author dislikes it too. He faces a 'condition, not a theory' which is quite too common in schools of pharmacy and medicine, in which inadequately prepared men must be given technical instruction when they should be at work on the underlying and antecedent subjects. What can one do with a student in pharmacognosy who has not had a good training in plant histology, and systematic botany? He must give such 'short-cut' training as the time will permit, and then push his half-prepared men into their technical work; and who can affirm that this is not the best solution, under the circumstances?

The book before us devotes one hundred pages to a rapid and rather superficial examination of the cell, the vegetative, and the reproductive parts of the plant, and this is followed by over two hundred pages relating to crude and powdered drugs, a few pages in regard to reagents, and finally the descriptions of the seventeen plates at the end of the volume. Throughout the first part the whole intent appears to be to prepare the student in the shortest possible time to know the application of every term which he is likely to meet in his subsequent work, and to know how to treat the different specimens he has to take up. The student is not made a botanist, by any means; he is put in possession of a lot of empirical information so that he may be able to make some sort of study of drugs. And no doubt as long as the colleges of medicine and pharmacy admit such illy prepared men, this is a wise course to pursue, and this book thus becomes a useful text for such students. The lesson to be derived from it is that botanists should insist that if pharmacognosy be taught at all, the students should have better antecedent preparation, by having taken courses in plant histology and systematic botany. Were this accomplished, pharmacognosy would become a part of scientific bot-

any, and the study might have much greater value to medical and pharmacal students.

AMATEUR SYSTEMATIC BOTANY.

A FEW days ago there came into the writer's hands a pretty little book, 'Fieldbook of American Wild Flowers,' by F. S. Mathews (Putnam's Sons), which is so suggestive and helpful as to appear worthy of some notice here. Its title is misleading, since the book is by no means 'American' in its scope, its range being confined to what we are calling 'northeast North America,' that is, practically the region covered by Gray's 'Manual.' This should be corrected in subsequent editions, or we may have anxious amateurs in Georgia, Texas, Wyoming, Montana and Arizona trying to fit western plants to eastern names and descriptions. It is not right that the title should be so much larger than the work itself. It is a fieldbook for a restricted portion of the country, and this should be clearly stated.

The book includes species of seventy-two families of flowering plants, the word 'flowering' being interpreted popularly, so that grasses, sedges, willows, oaks, elms, etc., are omitted as not having showy flowers. The arrangement of the families is that of Engler and Prantl. The species are described quite non-technically, and this work is so well done that the book should enable any one to identify every plant included in its pages. The many excellent plates, many of which are colored, will greatly help the beginner. The book is worthy of many editions, and no doubt will stimulate many a person to know more about the common wild flowers.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

RECENT ZOOPALEONTOLOGY.

THE COPE PAMPEAN COLLECTION.

THIS collection, representing the Pleistocene fauna of South America, includes three series of specimens, brought together by Ameghino, Larroque and Brachet, and sent by the Argentine Republic to the Paris Exposition of 1878. Professor Cope was so captivated by this collection that he purchased it outright, and brought it to this country. For more than twenty years it remained packed away out of sight in the cellar of Memorial Hall in Fairmount Park, Philadelphia. The American Museum of Natural History has acquired the collection from the executor of the Cope estate through funds subscribed by six of its trustees, Messrs. H. O. Havemeyer, William E. Dodge, D. Willis James, Adrian Iselin, Henry F. Osborn and the late James M. Constable.

It includes a very full representation of the Pleistocene fauna of South America, among which are a considerable number of type and figured specimens, all, with one exception, described or figured by Florentino Ameghino. The gem of the collection, now being mounted for immediate exhibition, is the skeleton of a very large specimen of the saber-toothed tiger belonging to the genus *Smilodon;* it lacks only the fore feet, which have been supplied from casts taken from the skeleton in the Museum of Buenos Aires.

The following specimens are especially noteworthy. Among the smaller Carnivora the type skeleton of *Conepatus mercedensis,* finely preserved, consisting of skull, jaws, limbs and about half the vertebræ. Among the rodents is *Lagostomus,* including various skulls and skeletons, which may be combined for a complete mount. The Litopterna are represented by the jaws and upper teeth of *Macrauchenia.* Of the Toxodonts, there are a skull and jaws, and separate limb and foot bones. The Proboscidea are represented by the fore and hind limbs and tusk of the Pampean mastodon. Among the Edentates are the following: Armadillos—*Eutatus brevis,* type skeleton in fair condition; *Dasypus,* skull, jaws, and a third of the carapace and skeleton; Glyptodonts—*Panochthus frenzelianus,* type skeleton lacking the vertebræ and teeth, but including the carapace casque; the skull, jaws, casque and carapace of two other specimens of *Panochthus;* skull, jaws and limbs of other specimens; *Dædicurus,* carapace; *Hoplophorus,* a fairly complete skeleton, except some vertebræ, with carapace, casque and tail-shield included. Among the ground-sloths there is a nearly

complete skeleton of *Lestodon armatus,* which can be mounted for exhibition, a large animal approaching the megatherium in size; *Lestodon myloides* is represented by a nearly complete skeleton which can be mounted, also by two skeletons of young animals; there is also a nearly complete skeleton of *Mylodon robustus,* which can be mounted by filling out the vertebral column with vertebræ of other individuals; this species is also represented by several incomplete skeletons and skulls; *Scelidotherium* is represented by two fine skulls, with a third of a skeleton, also by two inferior skulls with the greater part of the skeleton, but hardly sufficient to mount.

Work upon the preparation of this collection has already begun, and it will be pushed forward as rapidly as possible. It will be arranged partly zoologically and partly faunistically, in connection with the Patagonian collection made by Mr. Barnum Brown three years ago, which is now almost completely worked out for exhibition. The Patagonian types are largely ancestral to those of the Pampean, and while the latter contain an admixture of the northern forms, the faunal arrangement of these successive series so strikingly characteristic of South America will be of very great interest. H. F. O.

SCIENTIFIC NOTES AND NEWS.

Professor F. W. Clarke, of the U. S. Geological Survey, has been invited to deliver the Wilde lecture before the Manchester Literary and Philosophical Society next year on the occasion of the celebration of the hundredth anniversary of the propounding of the atomic theory at Manchester by Dalton. Professor Clarke will at the same time be given the Wilde gold medal of the society.

Dr. W. L. Bryan, president of Indiana University, has been elected president of the American Psychological Association.

The King of Denmark has conferred an order of knighthood on Lord Lister.

A marble bust of Sir William Muir, until recently principal of the University of Edinburgh, was unveiled on December 19. Sir William Turner received the bust on behalf of the university.

Professor H. V. Hilprecht, of the University of Pennsylvania, lectured on January 16 before the Anthropological Society at Berlin on his excavations at Nippur. He expects to return to America shortly, and will then leave on a further expedition.

Dr. Alfred Emerson, formerly professor of classical archeology at Cornell, has returned from a five years' absence in Europe and Asia Minor. He has recently been collecting antiquities for the Hearst collection at the University of California.

At the recent meeting of the Iowa Park and Forestry Association at Des Moines, Professor Macbride, of the State University of Iowa, gave the president's address. At a joint meeting of the Park Association and the Iowa Horticultural Society, Professor Shimek read a paper on the Iowa oaks. Professor Macbride was reelected president of the association.

Mr. John Hyde, statistician of the Department of Agriculture, has been awarded damages to the amount of $2,500 by the New Orleans courts against a firm of cotton brokers, which in December, 1901, caused a cable dispatch to be sent to Liverpool, England, to the effect that the United States Government cotton report was incorrect and unreliable, and intimating that the report was in the interest of speculators.

The *Alumni Register* of the University of Pennsylvania announces that Dr. Simon Flexner, professor of pathology, has received a grant from the Carnegie Institution, and that his assistant, Dr. Noguchi, has been appointed the first research assistant. It is reported in the daily papers that the Lick Observatory has received from the institution a grant of $4,000.

The Manchester Literary and Philosophical Society has awarded its Dalton medal to Professor Osborne Reynolds, F.R.S.

Professor Schwendener, of Berlin, has been elected president of the German Botanical Society and Professor von Wettstein, of Vienna, vice-president.

The Academy of Sciences of Göttingen has elected as corresponding members Professors Bezold (physics) and von Richthofen (geog-

raphy), of Berlin; Pfeffer (botany), of Leipzig, and Tschermak (mineralogy), of Vienna.

DR. WILHELM FÖRSTER, professor of astronomy at the University of Berlin, and director of the observatory, celebrated his seventieth birthday on December 16.

THE council of the Geological Society of London has made the following awards for the present year: The Wollaston medal to Professor Rosenbusch, of Heidelberg, the eminent petrologist; the Murchison medal to Dr. Charles Callaway, who has done much good work on the older rocks of Britain; the Lyell medal to Mr. F. W. Rudler, who recently retired from the post of librarian and curator of the Museum of Practical Geology, in which he gave untiring assistance to the many who sought his advice; the Prestwich medal, of which the award is made this year for the first time, to the fellow-worker and friend of Prestwich, Lord Avebury; the Bigsby medal to Dr. H. M. Ami, of the Canadian Geological Survey. The balance of the Wollaston fund has been awarded to Mr. L. L. Belinfante, the assistant secretary of the society, in recognition of his valuable services. The Murchison fund is allotted to Mrs. Robert Gray, of Edinburgh, whose collection of Girvan fossils, described by H. A. Nicholson and R. Etheridge, Jr., has been of great service to many geologists. The Lyell fund is divided between Mr. S. S. Buckman, whose work on the paleontology and stratigraphy of the lower oolitic rocks is so well known, and Mr. G. E. Dibley, who has done valuable work in collecting fossils and working out their zonal distribution in the chalk of Kent.

THE board of trade has appointed Professor Wyndham Dunstan, F.R.S. (now director of the Scientific and Technical Department of the Institute), to be director of the Imperial Institute at South Kensington. Professor Dunstan will continue in charge of the scientific investigation of economic products, and will supervise any other branches of work carried on by the Board of Trade in the building at South Kensington, including the collection of products of the empire so far as they will be under the control of the board.

JOHN B. HENCK, formerly professor of civil engineering in the Massachusetts Institute of Technology, died in California on January 3 at the age of eighty-seven years.

DR. BUSHROD WASHINGTON JAMES, the Philadelphia oculist and homeopathic physician, author of books on Alaska and other scientific topics, died on January 6, aged sixty-seven years.

MR. JOHN NATHANIEL CLARK, known for his work in ornithology, died at Old Saybrook, Conn., on January 14, at the age of seventy-two years.

THE death is announced of Dr. Henry Edward Schunck, near Manchester, on January 13, at the age of eighty-two years. He retired from business at an early date, and devoted himself to the study of chemistry, publishing important papers on organic coloring matters. He was fellow of the Royal Society, and had been president of the Manchester Literary and Philosophical Society and of the Society of Chemical Industry.

WE regret also to record the deaths of Professor Leonard Landois, professor of physiology at the University of Greifswald, and of M. Goubet, the inventor of the submarine torpedo boat bearing his name.

MR. CARNEGIE has intimated to the provost of Greenock that he is prepared to present to a properly authorized authority in the town the sum of $50,000 to defray the cost of the erection of a memorial to James Watt.

THE annual meeting of the board of regents of the Smithsonian Institution will be held at Washington on January 28.

AT the annual meeting of the managers of the New York Botanical Garden, two research scholarships were established. It was announced that forty-three investigators had availed themselves of the privileges of the garden during the past year. About 67,000 specimens have been received by the museum and herbarium and about 90,000 specimens have been added to the collection.

AT a meeting of the New York Zoological Society on January 13, it was announced that seven hundred thousand people had visited

the park last year. The aquarium, which is now controlled by the society, is visited daily by fully five thousand persons.

The French government has established a bacteriological institute at Bangkok, Siam.

The coast survey steamer *Bache,* which was lately fitted out for service on the coast of Porto Rico, will make surveys for charts and maps of the coast of the island.

The young women doing research work at the University of Michigan have organized the Women's Research Club of the University of Michigan. The officers are: president, Lydia M. DeWitt, B.S., M.D., who is doing work in histology; vice-president, Maud DeWitt, B.S., zoological department; secretary, Ellen B. Bach, A.B., botanical department; and treasurer, Frances Dunbar, zoological department.

The Friday evening meetings of the Royal Institution of Great Britain will be resumed on January 16, when Professor Dewar will give an address on 'Low temperature investigations'; on January 23, Dr. Tempest Anderson will speak on 'Recent volcanic eruptions'; on February 13, Professor Sheridan Delépine will give a lecture on 'Health dangers in food'; on February 27, Dr. Adolf Leibmann will speak on 'Perfumes, natural and artificial'; on March 6, Professor J. G. McKendrick on 'Studies in experimental phonetics'; on March 13, Professor Karl Pearson on 'Character reading from external signs'; and on March 20, Professor Schäfer on the 'Paths of volition.'

UNIVERSITY AND EDUCATIONAL NEWS.

During the last few weeks, Cornell College, Iowa, has added $71,500 to its endowment funds. A friend whose name is not yet made public gave $50,000. Mr. Fred W. Brown, of Belle Plain, Iowa, has given $10,000. Work on the Carnegie library will be begun early in the spring, as $40,000 of the endowment necessary for its maintenance has been secured and only $10,000 more is necessary. There are upwards of 600 students in the institution.

The exercises at the installation of William Lowe Bryan, Ph.D., as president of Indiana University are as follows:

JANUARY 20, 2.30 P.M., FOUNDATION DAY EXERCISES, EIGHTY-THIRD ANNIVERSARY OF THE FOUNDING OF THE STATE SEMINARY.

Address on behalf of the trustees: Honorable Benjamin F. Shively; address on behalf of the faculty: Professor Ernest H. Lindley; address on behalf of the alumni: President Joseph Swain, Swarthmore College; addresses on behalf of the State.

8 P.M., RECEPTION TO DELEGATES AND VISITORS.

Welcome to visitors: Professor Gustaf E. Karsten, *Chairman of Committee;* responses by delegates.

JANUARY 21, 9 A.M., DEDICATION OF SCIENCE HALL.

Address by Professor Edward L. Nichols, Cornell University; address by Professor John M. Coulter, University of Chicago; address on behalf of the university, by Professor Arthur L. Foley.

2:30 P.M., INSTALLATION OF THE PRESIDENT.

Address by President W. H. P. Faunce, Brown University; address by President E. Benjamin Andrews, University of Nebraska; installation of President Bryan by Chief Justice Hadley, Indiana Supreme Court; address by President Bryan.

The Treasury has given its assent to the scheme by which Reading Corporation acquires the site and buildings of the University College for the purpose of extending the municipal offices, etc., at a cost of £50,000. The college, in exchange, obtains a much larger site on the London-road, whereon it is intended to erect a handsome pile of college buildings.

Professor Lehmann-Hohenberg has been dismissed from his chair at the University of Kiel for criticizing the courts. We do not know how far this action may have been warranted, but it appears somewhat remarkable that the disciplinary court should state that university professors, being officers of the government, are not permitted to criticize the government.

At Purdue University Mr. L. V. Ludy has been placed temporarily in charge of the department of analytical and applied mechanics and Mr. J. A. Thaler has been appointed instructor in analytical and applied mechanics.

Mr. J. S. MacDonald, assistant lecturer in physiology at University College, Liverpool, has been appointed professor of physiology at University College, Sheffield, in succession to Professor Myers-Ward, who goes to Charing Cross Hospital as lecturer in physiology.